THE

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J. A. BERLY'S

UNIVERSAL ELECTRICAL DIRECTORY

For 1893

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THE TELEPHONE QUESTION.

THE article on the Telephone Companies which we published two weeks ago has been commented upon by two of our contemporaries—each in its own way—and, as the subject is important, we refer to it again.

The *Electrical Engineer*, as might be expected, treats the subject seriously. It thinks we made some strong statements upon less careful examination of the position than is usually the case, and it draws inferences, contrary to our views, from information with which it has been furnished.

Lightning, in its Review columns, quotes our article, and, presumably referring to a previous discussion in our columns, says:—"The REVIEW on this occasion got mixed between *square inches* and *inches square*, and its opinions are necessarily rather inconclusive." We recognise that our contemporary, desiring to furnish its readers with accurate impressions as well as accurate information, would not have inserted such a paragraph unless it supposed there was some element of truth underlying the impression conveyed. It did not, of course, follow the discussion in our own columns, or it would have remembered the fact as well as the flaw. We are aware that one of its correspondents endeavoured to convey the impression that an inversion of words invalidated our argument, and we are also aware that in the same letter the correspondent did himself the injustice of misquoting his own work in the same way that we had inadvertently done. In this we see no palliation of the enormity of our own offence; we only mention it so that our contemporary, finding the balance of verbal error more even than it supposed, may be induced to consider the facts on their merits, and so avoid the expression, on superficial examination, of opinions which must necessarily be rather inconclusive. As we were dealing with entities, and not juggling with figures, our opinions are conclusive, and our arguments need no more than the correction in words that they immediately received at our hands.

The information furnished by our contemporaries is that the National Company is adopting the Law system at Glasgow, contemplates similar changes in other towns, and is in other respects adopting Mr. Bennett's improvements; and the inference, in the one case, is that "Mr. Bennett's influence has been felt," and, in the other case, that it is "a far more important argument than what the REVIEW says."

We readily admit that we know no more about the practice and policy of the National Telephone Company than is generally known. It was generally known months ago that the Glasgow Exchange was in process of transformation to the Law system. How long it has been in progress we cannot say, but it must have been long before Mr. Bennett's influence could have been felt in the policy of the amalgamated, or combined, or entwined companies, and we should not be surprised to hear that it was decided on before the B.A. paper was read.

We have not heard that any of Mr. Bennett's improvements have been adopted. It seemed to us that almost the only novel feature about the British Association proposals was the electrostatic call-wire. We do not know whether that is being adopted at Glasgow, but we assume not.

We frankly recognise the difficulty in which we are placed when both of our contemporaries refer to one subject as having been commented upon by us. It seems unreasonable that they should both have read us incorrectly, and yet we certainly have no recollection of expressing the views, or holding the opinions, with which they credit us. It is with reference to the "Mutual switchboard at Manchester." The *Electrical Engineer*, says that subject to defective memory or reference on its part, we decided the switchboard "could not possibly work," and *Lightning* says that "it was this switchboard which was such an offence to the REVIEW." We assure our contemporaries that we have a greater regard for our responsibilities than to express an opinion, decided or otherwise, on the working of apparatus which we have not seen, and of which we have no description before us, and we do not readily take offence when individuals are concerned, much less so with inoffensive apparatus. We took some trouble to express our views, and it is not encouraging to find that in two entirely different quarters we are credited with views which we believe to be entirely unfounded. We did not express an opinion on the working of a switchboard. What we did was to show that certain figures relating to switchboards in the B. A. paper were inaccurate, and we not only said so but proved it.

We may now refer more specifically to the arguments of our contemporaries, so far as they are intended to modify the remarks in our article of February 10th, commenting on the *Standard* article. The information furnished by our contemporaries in no way supports the inferences they draw. The adoption of the Law system at Glasgow is not the adoption of the plan put before the British Association. The main features of that plan are easily observed from our criticism of September 11th, 1891. They were :—1. Numerous exchanges; 2. The Mann (*i.e.* Law) system. We have not heard, and we shall be very surprised to hear, that numerous exchanges are being adopted in Glasgow. We are not surprised at the adoption of the Law system. We said it had many ardent adherents besides Mr. Bennett. In our remarks upon it we expressed no opinions except such as were deduced from stated facts, and the adoption of the Law system at Glasgow, or elsewhere, in no way alters the facts. We regard its adoption as an interesting experiment, the result of which we shall watch with interest, and the success of which we shall be glad to chronicle. But there is no comparison whatever between the adoption of the Law system in a single exchange in Glasgow and the adoption of the Law system in thirty-two, or even two exchanges in London. The permissibility of experiments is dependent on circumstances. A single experiment with reasonable probability of success may be justifiable in one place, a doubly doubtful experiment is not permissible in another. We are quite aware that our policy on this telephone question has been, to some, difficult to understand. We have seen the National Company criticised in no measured terms, and we have not joined in it. We distrust criticism which has plainly only company promotion at the end of it. We have even had the audacity to criticise proposals for opposition, which is alone sufficient in some minds to indicate our satisfaction with the existing state of things. Our friends may be assured that if we have not joined in the criticism of the National Company, it is not because we think them beyond criticism. If we have criticised alternative proposals, it is not because we are satisfied with the existing service, but because we have seen that the carrying out of such proposals would take us from bad to worse, and we would rather bear the ills we have than fly to those we know not of. We shall be quite satisfied if we succeed in producing the impression that the telephoning of London is a problem for the consideration of experienced and serious men. A mistake made now would take years to recover from, and mean considerable loss by subsequent changes. We recognise a difference between responsibility and irresponsibility. The directors of the National Telephone Company have a responsibility. If they make a mistake, their shareholders will inevitably suffer for it, as well as the public. The best way to avoid making mistakes is to let responsible people give adequate consideration to the lessons of experience, and not to let irresponsible people harass them with ill-considered criticisms, and assertions that paper proposals have received a useless public *imprimatur*. The Panama Canal would have been finished long ago if the practical difficulties could have been overcome by paper proposals and sanguine assertions.

THE PRACTICAL MEASUREMENT OF ALTERNATING ELECTRIC CURRENTS.

PROF. FLEMING'S Cantor Lectures at the Society of Arts have, as was to be expected, attracted large and attentive audiences. In proposing a vote of thanks to Prof. Fleming at the end of the fourth and last lecture on Monday evening, the 20th inst., Mr. Preece referred in eulogistic terms to the lecturer as a past master in the art of electric measurement, and as a no less equal master of the English language. To those privileged to attend these lectures this will appeal with considerable force, and no one could be better qualified to speak upon alternating current measurement, for it is a subject which Prof. Fleming has made peculiarly his own. Associated as he is with some of the largest and most influential of our electrical concerns, he has, to use his own expression, given us "the cream of experience rather than the skimmed milk of theory."

In being intensely practical and dealing with facts rather than with figures, the difficulties which, to some extent, still surround the subject have been surmounted and an advance been recorded, of which the results will be seen in practice within a very short time. It must be remembered that the subject was treated from the point of view of a specialist addressing himself to specialists, and for this reason alone the course is probably destined to be more fruitful of practical results than could otherwise have been the case. It would hardly be too much to say that this is the first attempt to cover the ground comprising the subject from a purely instrumental point of view, and to eliminate the mathematical gymnastics in which it is usually involved.

We shall give shortly the most novel arrangements described, and look upon the suggestion for station metering apparatus as being the plum of the discourse. Until the experiments of the lecturer with the Elihu Thomson record-

ing wattmeter, the common statement that it is impossible to directly integrate the energy on an inductive circuit has gone uncontradicted. The agreement between the value obtained by calculation from the readings of a dynamometer wattmeter and that given instrumentally by a Thomson recording wattmeter, is such as to console those whose stations are necessarily provided with an alternating converter system. Indeed, as was pointed out, the stigma which has rested up to the present on such systems, that no true measurements had been, or could be, made of the energy wasted in practice, bids fair to be removed by the adoption of the Fleming arrangement. The ingenuity displayed in arranging a converter to supply the shunt current for the wattmeter or energy-meter, is not minimised because such a method had been in use with pilot voltmeters for a considerable time. It is surprising that so obvious an adaptation had not been used before, for its advantages in reducing the tension on the shunt coil with attendant liability of leakage to earth, and the loss of energy which must take place where even a small current is taken for the volt coil on high pressure mains have been known, but the solution of the problem seems to have been left to Dr. Fleming. The new Kelvin wattmeter which gives directly on an inspectional scale the true watts being dissipated in the circuit to which it is connected, has the recommendations of compactness and small internal waste of energy, and attracted attention as being the first time of introduction to the public. It is probable that the Cantor Lectures of the present session of the Society of Arts, will, in the opinion of practical men, be considered second to none since the establishment of such courses.

The Elmore Companies.

IT seems incredible that the directors of the various Elmore companies should expect to be furnished with more money for the purpose of carrying on their various but not varied "enterprises." The parent Elmore asks for £20,000, the Wire Company for £50,000 and the French Company £50,000, all on debentures. That is to say that a further sum of £120,000 is asked for to be added to the hundreds of thousands previously sunk in the development of the same unfortunate process, or dissipated in the various company promotions. An appeal has been made to the shareholders to subscribe to these debentures in order to save their share capital. We have often commented upon the extraordinary patience and forbearance of Elmore shareholders, and wondered at the sanguine temperaments which could permit meeting after meeting to pass without some effective protest against the plausible reports which were submitted to them. But it would seem that their patience is at length exhausted, and the chances of their throwing good money after bad are not great, if we may judge from the eloquent plain-spokenness of one of them. The Rev. J. P. Foster, of Poulton Vicarage, Fairford, having been applied to by the chairman of the French Company writes in reply:—"In my opinion, for the sake of the many idiotic investors there are in the world besides myself, the sooner the Elmore bubble is pricked the better, and so I propose to send our letters to the papers and venture to warn my fellow-beings, with more faith than sense in their composite natures, to consign all Elmore circulars and private letters from you and from Mr. Rawson to the waste paper basket, unless they store them up, as I do, in the hope that some day they will prove to be useful evidence." Incidentally, we learn from this correspondence (which appeared in the *Financial News* of the 21st inst.), that "the circulars and reports" written by "a past master in the art of plausible statement and verbal puff" are responsible for the "investment" of much money in these concerns, and possibly also for much of the apparent patience. How much money might not have been saved to these investors had our advice been taken in the beginning. Yet the shareholders are not free from blame. Time after time we have set out these verbal puffs in their true inwardness, and shareholders have risen amid the applause of their fellows to condemn the "rags" which "depreciate their property," and have even visited our office to express the scorn with which they have regarded us. As we have hitherto tried to save them their money so we may now say a word to prevent their wasting their property. To subscribe money to be handed over to the same stewards is absurd; but the shareholders should thoroughly investigate their affairs and see if there is any possibility of utilising their plants, and failing that, to take care it is realised to the best advantage.

Deprez-D'Arsonval Galvanometers.

A PAPER read by Mr. Nelson H. Genung before the Franklin Institute on November 22nd, contains a short review of the history and improvements in the D'Arsonval galvanometer. There is nothing particularly original in the paper as regards suggestions of improvement, but those of our readers who are interested in the matter will find an account of the new Queen-D'Arsonval instrument. It is not quite clear where Her Majesty comes in, but we presume the number of inventors was so great that the American papers put "Queen" inclusively, to represent "the true embodiment of everything that's excellent." The Deprez-Kelvin-Ayrton-Perry-Carpentier-Gaiffe-Ledeboer-Mather-Sumpner-D'Arsonval galvanometer is too extended for practical purposes, and yet they all have a few turns in it.

The Goebel Defence.

The *Electrical Engineer* (New York) for February 1st, gives a *resumé* of the continued legal proceedings between the General Electric Company and the Beacon Vacuum Pump Company. No further points of a very striking nature seem to have been advanced on either side, excepting, perhaps, the declaration of Mr. Leonard Curtis, who explains to some extent how it was that the Goebel matter has not been brought up in previous cases. Affidavits by Prof. Thompson and Messrs. Howell and Randal, were put in by complainant's council to rebut the defence. The former stated that he knew Goebel as early as 1881-2, and heard his claim to priority, but had little faith in it; though the officials of the American Electric Company placed reliance on it. He felt sure the three lamps exhibited were never practically operative, though they might have burnt a little. The two other affidavits concurred with Prof. Thompson respecting the structure and effects of the exhibits. The affidavit of Mr. Curtis stated that he saw claimant early in 1882 and heard his story, but he had some difficulty in understanding him, as his knowledge of English was imperfect. He was impresed with his apparent truthfulness. He failed, however, to get track of any witnesses to corroborate the statements, and eventually let the matter drop, through his erroneous notion that Goebel's experiments had been discontinued within a year or two of 1850. Had he known that evidence existed to the extent now produced, it would certainly have been used in prior suits against the Edison Company. At the conclusion of the arguments the Court announced that one week would be granted for printing the papers and filing the briefs by council on both sides. The case will, therefore, be very soon decided.

THE ELECTROLYTIC PRODUCTION OF CHLORINE AND SODA.

By EMILE ANDREOLI.

THE paper on "The Electrolytic Production of Chlorine and Soda," read by Messrs. Cross and Bevan at the Society of Chemical Industry, reminds me of the very consoling words of Mr. Bevan at the Institution of Electrical Engineers, during the discussion on the "Problems of Commercial Electrolysis":—"I believe that the electrolytic production of soda will pay very handsomely. I believe it will be the process of the future."

The opinion expressed by Messrs. Cross and Bevan in their paper is not less suggestive of the confidence they have in the commercial applications of electrolysis to the manufacture of soda and bleaching powder, as they conclude with this declaration: "Such, then, is briefly the present position of electrolytic soda and bleach. We have tried to show that, under by no means extravagant conditions, they can be produced at a price which, at the present selling prices, leaves ample margin for profit."

I have the bad or the good habit of always looking first at the end of an article, pamphlet or paper, and then at the beginning, to form an idea of the subject and of the inferences drawn, so that I may see if it is worth reading at all.

I was rather disappointed to find, after a solemn statement on the electrolytic production of soda and bleaching powder, "which is of a very considerable technical interest, is very enticing, and has of late years occupied a good deal of attention, and attracted the attention of inventors," that the authors did not, as promised, "discuss the problems in general terms, in the hope that they should be able to show the feasibility of an economical electrolytical process."

It is hardly fair of Messrs. Cross and Bevan to say that it is only within the last few years that any considerable advances have been made.

The truth is, that it was an impossibility 25 or 30 years ago to start an installation, not on a large scale, but even on a very moderate scale of ½ cwt. bleaching powder per day. There were no dynamos. Electricity was almost pure science, and was not born as an industry, and inventors had no means to prove the efficiency of their processes. But if we look only into the merits of their methods, and of the principles on which they were based, we find that there is not, generally speaking, a great difference between the electrolytic tanks of the past and those of the present. The materials and the construction of the electrodes may be different, the shape of the tanks may have been modified or altered; but, with very few exceptions, what the old inventors did in contriving to generate chlorine and soda, modern inventors imitate, and they all do this more or less successfully.

We must therefore render justice to the pioneers of electrolysis, and recognise that most of our electro-chemists have simply improved the apparatus devised and worked by others who have prepared the way.

Messrs. Cross and Bevan said that they would describe somewhat in detail the two processes of Greenwood* and Le Sueur, of which they had some practical experience.

The Le Sueur electrolytic tank is very little known; it consists of an iron tank fitted with a sloping floor, on which rests the cathode; this is formed of a ring of iron filled with several pieces of iron wire gauze. Several small holes are drilled in the top part of the ring to allow of the easy escape of the hydrogen. The floor of the tank is also sloped for this purpose. The diaphragm rests on the cathode. It consists of two parts: a sheet of ordinary parchment paper and a double sheet of asbestos cemented together by means of coagulated blood albumen. The diaphragm being placed in position, the inner vessel of earthenware is placed on it and by its own weight makes a water-tight joint. There are usually 6 to 12 electrolysers in each tank. Inside the vessel has been previously placed the anode. This consists of pieces of ordinary retort carbon imbedded in a mass of lead, through which electrical contact is obtained.

The cell being in position, a saturated solution of salt is run into the outer vessel until it reaches just above the upper edge. The anode section is filled with similar solution to a level about half-an-inch above that of the solution in the cathode section. The object of this is to prevent any transference of solution from the outer to the inner vessel, this being more harmful than the reverse. The diaphragms are renewed every 48 hours; to effect this, the whole of the inner vessels in any tank are simultaneously raised. As the carbon of the anodes wear away, they are lowered by means of screws, so as to bring them as near as possible to the cathodes. After working for 6 to 8 weeks, they have to be renewed. For this purpose the cells are taken to pieces and the lead melted and re-cast.

When the electrolysis has been continued long enough for the solution of caustic to reach a strength of about 10 per cent., the liquor is run away, and the alkali precipitated as bi-carbonate.

Messrs. Cross and Bevan discuss the problem from the point of view of cost, in the following estimate, based on figures obtained from the actual working of Le Sueur's system, on a scale of ½ ton of bleaching powder per day, and they add that with the exception that the cost of plant would vary with every process, the figures may be taken as fairly representative of other processes. They take as basis, an output of 2,400 I.H.P. hours (which requires two engines of 200 H.P. each). They take the H.P. hour at 2½ lbs. of coal, and the cost of power is therefore

		£	s.	d.
64 tons of coal at 10s. per 24 hours		32	0	0
The labour (8 day men and 8 night men at 30s.)		4	0	0
Depreciation at 10 per cent.:—Engines, £10,000				
Boilers, 7,000				
	£17,000	5	14	0
Oil and waste		1	0	0
		£42	14	0

This would give 0·71 of a farthing as the cost of 1 H.P. hour; but, although such may be the case in some model installations of the most perfect machinery, it is not safe to calculate on the minimum of cost of motive power, and instead of representing the cost of the horse-power at such a low rate, which may be a source of disappointment in paper mills, it would be wiser to adopt 0·33 of a penny as the cost not of a kilowatt, but of 1 H.P. hour.

The decomposition of salt requires 4½ volts, and if we divide by 4½ the number of E.H.P. (2,000 × 746) = 1,492,000 watts), we find that the current is 331,555 ampères = 7,957,320 ampère hours.

The theoretical yield of chlorine is 0·00292 lbs. per ampère hour, therefore 7,957,230 × 0·00292 = 23,325 lbs. of chlorine per 24 hours.

This, converted into grammes, would give 0·00292 × 453 = 1·323 grammes per ampère hour, and, on the basis of an efficiency of 80 per cent., it equals 1·058 grammes, *i.e.*, 8,426 kilogs., 801·880 grammes per 24 hours, equal to 22·43 tons of bleaching powder containing 37 per cent. chlorine.

On another hand, given that 1 ampère hour yields theoretically 0·0033 lbs. of caustic soda (*i.e.*, 1·4949 grammes), we find that at a rate of 80 per cent. efficiency this equals 1·19592 grammes, or a yield of 9·378 tons of caustic soda, or 12·426 tons of ash per 24 hours.

The selling price of these commodities shows that:—

	£	s.	d.
22·43 tons bleach at £7 10s. = ...	168	4	6
9·378 tons caustic at £12	112	10	9
	£280	15	3
22·43 tons bleach at £7 10s.	168	4	6
12·426 tons ash at £5 15s.	71	9	0
	£239	13	6

Now, as to the cost of 23 tons of bleaching powder and

* In one of my articles on "Commercial Electrolysis," I had stated that the Phœnix Wharf Works were closed; I was simply repeating what I had been told and what I had read in some papers; it appears that they were momentarily closed, that the work has been recently resumed, and that there is a large installation in construction in Germany.

9·378 tons of caustic, or 12·426 tons of ash, Messrs. Cross and Bevan find that it does not exceed £121; it is not so much as the saving realised by the Hermite process over the old methods of bleaching paper pulp and cotton with bleaching powder, and which, exclusive of water-power, was stated by Mr. Cooper as amounting to 80 per cent. Still it is a very handsome profit; but what is mysterious in the following estimate is that the ton of salt is quoted 12s., and I cannot imagine how actually salt is no more expensive than lime:—

	£	s.	d.
18 tons salt at 12s.	10	16	0
12 tons lime at 12s.	7	4	0
Power 2,400 × 24 = 57,000 H.P. hour at ¼d. ...	60	0	0
Labour	10	0	0
Casks and packages	18	0	0
Depreciation at 10 per cent. for 300 days on			
Electrolysers £12,000			
Dynamos 8,000			
Tanks, pumps, buildings 10,000			
£30,000			
	10	0	0
Superintendence	1	0	0
General expenses	4	0	0
	£121	0	0

This reminds me of what a contemporary said last year on the Greenwood process:—

"It appears that the commercial efficiency of the process is 75 per cent., but Mr. Preece is of opinion that better results may be looked for in actual practice. He calculates the cost of producing electrical energy in the coal districts, with triple expansion modern engines and dynamos, working continually at full load, to be ⅓d. per kilowatt-hour, and that, therefore, the cost of breaking up one ton of salt will be £3 7s. 8d., while by the use of water-power, this estimate can be reduced one-half. According to these figures, the total cost of production of caustic soda and bleaching powder will be *little more than one-third* of their present market value. The electrolytical efficiency given above is confirmed by Messrs. Cross and Bevan, who find it to be 80 per cent., as against 75 per cent. given by Mr. Preece. The pressure needed for each tank to overcome the resistance of the electrolyte and diaphragm, and to affect the work of electrolysis, is given as 4·75 volts at the beginning of the process, falling to 4·36 volts after running for a short time. No figures are available for determining how much of this must be assigned to each item—a point of some importance.

"A current density of 10 ampères per square foot is used. Mr. Greenwood has made an estimate for a plant capable of turning out 50 tons of caustic soda and 125 tons of bleaching powder per day of 24 hours.

	£
5,000 tanks and fittings	125,000
Engines, boilers and dynamos	50,000
Buildings and extra plant	25,000
	£200,000

COST OF PRODUCTION Based on the Tests and Reports.

	£	s.
Cost of electrical energy, including coal, labour, maintenance and depreciation	210	0
Salt and lime	77	10
Labour and incidental expenses	50	0
Evaporation of caustic	25	0
Depreciation and maintenance	50	0
Packages and packing	100	0
	£512	10

MARKET VALUE OF THE PRODUCT.

	£	s.
50 tons of caustic soda at £11 10s.	575	0
125 „ bleaching powder at £7 10s.	937	10
	£1,512	10

Net profit per day, £1,000."

Undoubtedly the Greenwood process is very promising, but as a rule it is wiser to take any too sanguine estimate for what it is worth, and with a small grain of chloride of sodium. The strongest believer in electrolysis would be more reserved in his calculation, and it does more harm than good to indulge in such big figures as £1,000 net profit per day.

What is extremely remarkable in the paper read by Messrs. Cross and Bevan, is that they say in the beginning that:

"The chief difficulties of the economical manufacture of alkali and bleach by electrolysis have hitherto been: (1) The devising of a diaphragm of such *low resistance* as would allow the electrolysis to proceed with a reasonable low electromotive force, and which would at the same time *effectually prevent* the re-combination of the products of electrolysis; and (2) The construction of an *anode which would stand wear and tear*."

From this one might expect that the Le Sueur process which Messrs. Cross and Bevan recommend as good, efficient, and very cheap, is characterised by the use of a diaphragm and of an anode which possess the above ideal properties and perfection.

But, unfortunately, the Le Sueur diaphragm, as a matter of fact, must be *renewed every 48 hours*, and the anodes have to be renewed *after 6 or 8 weeks*, and for this purpose the cells are taken to pieces and the lead melted and recast.

I am at a loss to understand why chlorine and soda are constantly put forward and spoken of, as though a good electrolytic apparatus was not as efficient also for producing oxygen and hydrogen, or decomposing sulphates, nitrates, and other binary compounds, as for generating chlorine and soda.

What are really the advantages of Le Sueur's system? The construction of the apparatus not only is not simple, but is of a complicated character; Messrs. Cross and Bevan do not give any details on its working, on the surface of electrodes, the rate of current per square foot, the exact E.M.F., the counter electromotive force, the temperature, the real yield of chlorine and soda per ampère hour. We expected from Messrs. Cross and Bevan the technical observations and the figures obtained during their experiments, and not the balance-sheet which they elaborately put before us, and which looks very much like those reports on primary batteries by scientists who, as fairy godmothers, predict prosperity and happiness to the intending purchasers.

Messrs. Cross and Bevan conclude by remarking that the Hermite process, which has proved itself highly successful on the Continent, is destined to play a very important part in the future development of the alkali industry. I hardly see how this prediction can be realised.

Mr. Preece the other day said that the electrolytic caustic soda and chlorine industry is not yet a staple one. I venture to say that if the electrolytic chlorine and soda are not yet, commercially, things of the present, hypochlorite will be soon a thing of the past, as there will always be more advantage in producing even 1 gramme chlorine and 1 gramme caustic soda per ampère hour, than in forming a hypochlorite solution (with a great loss of salt), the strength of which cannot economically be brought to a higher strength than 3 grammes chlorine per litre.

It is a satisfaction, unknown up to the present to the electricians, to read in the report of Mr. Leith of St. Helens, a formal declaration that Messrs. Richardson and Holland have overcome all the main difficulties hitherto impeding alkali manufacture by electrolysis, and that if large works were erected either in the north, near the supply of coal and salt, or wherever good water power is available to save the cost of fuel, both chloride of lime and caustic soda can be manufactured under the patents of the Electrolytic Caustic Soda and Chlorine Trust, of Snodland, at a saving of about £5 per ton on the present prices charged for these articles by the Chemical Union at St. Helens or Widnes.

The following shows that the process has been and is still worked on a practical scale. The steam engine evaporating plant on the premises at Snodland are sufficient to turn out far larger quantities than are now done. During the period Mr. Leith had the control of the works, he used only 13 out of the 21 brine decomposing tanks fixed, and turned out over 5 tons 8 cwts. at a time; the electric current has been continuously maintained day and night, from 500 to 520 ampères at 80 volts; the indicated horse-power of the engine has been 81, friction included. This, however, with a more modern class of engine might be reduced to 50 horse-power, and the cost of coal by, say, 35 per cent.

The statement is based on the present cost of production of this quantity at the Snodland Works, packed and ready for transport.

Dr.	£	s.	d.
Wages, 2 stokers and 3 labourers	11	0	0
Coal, at 2½ lbs. per indicated horse-power, at 11s. per ton ...	11	18	8
Coal for evaporating caustic	1	13	3
Salt, 45 cwts. at 1s. per cwt.	2	5	0
Lime, 70 cwts. at 1s per cwt.	3	10	0
Drums and casks ...	2	18	6
Balance	15	7	1
	£48	12	6

Cr.	£	s.	d.
77 cwts. bleach, 35—37 per cent., at 8s. ...	30	16	0
31 cwts. caustic, 76 per cent, at 11s. 6d. ...	17	16	6
	£48	12	6

The wages charged above would be sufficient to turn out a much larger quantity of finished caustic and bleach. Mr. Leith calculates that the cost of manufacturing, say, 180 tons per week, *i.e.*, 52 tons of caustic soda 76 per cent., and 128 tons of bleach 35 to 37 per cent. at St. Helens, would leave a profit of £5 per ton, thus proving the very great value of the Holland and Richardson process.

Dr.	£	s.	d.
Wages:			
10 stokers, 4s. 6d.	15	15	0
4 men 5s.; 4 boys 3s.	11	4	0
2 caustic finishers ...	4	0	0
2 lime dressers ...	3	0	0
4 bleach packers ...	9	0	0
6 labourers	6	0	0
loco. driver and brakesman	4	0	0
discharging and loading	25	0	0
Coal for boilers, 650 tons at 4s. 4d.	138	2	6
Coal for evaporating soda... ...	24	4	6
Salt, 100 tons... ...	32	10	0
Lime, 95 tons at 13s.	61	15	0
Drums and casks ...	85	0	0
Add 50 per cent. on cost of manufacture, for office management, rent, rates, taxes, repairs, and contingencies	209	15	6
Balance ...	902	13	6
	£1,532	0	0

Cr.	£	s.	d.
52 tons caustic, 76 per cent., at £11	572	0	0
128 tons bleach, 35 to 37 per cent. at £7 10s. ...	960	0	0
	£1,532	0	0

The production of chlorine and soda by the electrolysis of chloride of sodium is therefore an accomplished fact, and we must expect that other electro-chemists will soon follow Messrs. Holland and Richardson in the field of success.

I will not spoil the day by criticising their process or discussing whether their patents are weak or not.

A METHOD OF CORRECTING THE REGULATION CURVES OF GENERATORS.*

BY GEO. L. THAYER.

ONE of the most serious difficulties met with in testing direct current dynamos is the difficulty of keeping the machine up to speed. When the design of new machines depends upon the results of a test it becomes very important to know just what the regulation is going to be, especially in the case of compound machines. The E.M.F. is by no means proportional to the speed in self-excited machines. The well known fact that compounded machines are very sensitive to variation in speed of the engine shows this. A variation in dynamo speed due to engine regulation and belt slippage of less than two per cent. will quite destroy the self-regulation of the machine.

In the case of separately excited and arc light machines the E.M.F. may be assumed to vary as the speed, and the curves from the machine may be connected accordingly. With a shunt machine this cannot be done. A change in speed in such a machine causes a change in E.M.F. considerably greater. This variation may be classed under two heads: First, that due to the change in speed, assuming the field to remain the same; and, second, that due to the increased strength of field due to the first change. Now if this ratio can be found, the E.M.F. of a machine can be computed accurately enough for all practical purposes, when the speed varies.

Call this ratio r.

Let E = E.M.F., as observed;

„ E_1 = E.M.F., corrected for speed alone;

„ E_2 = E.M.F., corrected for speed and change in strength of field.

Let $T_w C$ = ampère turns in shunt coils as observed;

„ n and n_1 = observed and standard speeds, respectively.

From the magnetisation curve in the region in which the E.M.Fs. will lie, find the ampère turns on the field necessary to produce a change of one volt. Call this value T. When working near the knee of the saturation curve the mean value for the probable range of E.M.F. should be taken. The new E.M.F. due to change in speed alone is

$$E_1 = \frac{n_1}{n} E.$$

The change in E.M.F. due to the change in field strength alone is, since the shunt field current varies as the impressed E.M.F.:

$$E_2 - E_1 = T_w C \frac{E_1 - E}{E} \times \frac{1}{T}.$$

By definition $r = \frac{E_2 - E_1}{E_1 - E}$.

Substituting and applying Ohm's law,

$$r = \frac{T_w C}{E \times T} = \frac{T_w}{R} \times \frac{1}{T}.$$

R is the resistance of the field plus the portion of the rheostat in use. As the temperature of the field changes the resistance, R is best computed from the observed values of E.M.F. and field current.

The E.M.F. corrected for speed and change in field excitation, is then

$$E_2 = E_1 + r(E_1 - E).$$

But this does not take into account the change in field current in passing from E_1 to E_2. This further change in E.M.F. is evidently

$$r(E_2 - E_1) = r^2(E_1 - E).$$

This series of approximations may be continued, giving

$$E \text{ (final)} = E_1 + (r + r^2 + r^3 + \&c.)(E_1 - E).$$

This series is always a converging one and the equation then takes the form

$$E \text{ (final)} = E_1 + \frac{r}{1 - r}(E_1 - E).$$

This value is an approximation, but it is within the limits of errors of observation. The value of the series will run from 0·5 in machines with a large air gap, or working above the knee of the saturation curve, to 1·5 when the field is not saturated.

The value of the coefficient of $(E_1 - E)$ is a function of the number of ampère turns necessary to change the E.M.F. one volt. If the E.M.Fs. vary greatly, and if the generator is working near the knee of the saturation curve, it may be necessary to compute more than one value.

A modification of this formula can be used in correcting the regulation curves of composite-wound alternate current generators; but where the composite winding is small the value of the coefficient is small.

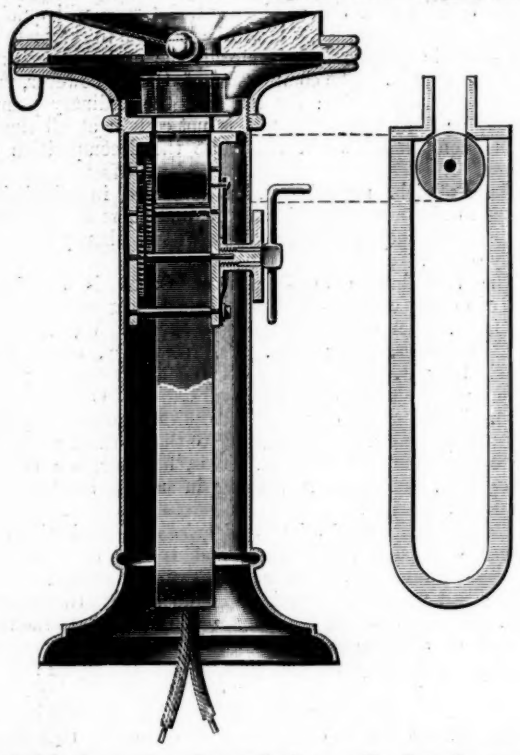
This method has given good results in the plotting of regulation curves from large compound multipolar generators. In a few cases where steam had dropped just before the last points of the curve were taken the corrected E.M.Fs. resulted in a satisfactory curve, although the drop in speed was almost 10 per cent.

* New York *Electrical Engineer*.

Home Rule Bill.—The amount of press work dealt with at the Central Telegraph Station on Monday night last week reached 750,000 words transmitted. This is not a record, for the figure has been exceeded, though not largely, on two or three former occasions.

SIEMENS'S TELEPHONE WITH SIREN-CALL.

THIS instrument, which is shown by the figure, consists of the well-known Siemens's Bipolar Telephone, with the addition of a special hand-worked arrangement for calling. The latter consists of two diametrically opposed segments of soft iron, forming part of a brass cylinder, which the operator can rapidly rotate by means of a small crank handle turning a train of wheels, gearing with the armature. This rotation causes a rapid introduction and removal of the armature from the magnetic field below the soft iron pole pieces, and a corresponding magnetic change in their cores, which affects the home as well as the distant telephone diaphragms, setting them both into vibration. In general the siren-like sound emitted by the telephone alone is quite suffi-



cient for the purpose of a telephone call; but the small bullet which is attached to the cord may be kept resting on the diaphragm, it is brought into violent movement by the vibration of the latter, and acts as an intensifier of the telephonic sound emitted.

The armature, if left to itself, would take up a position across the field below the poles, and weaken the magnetic field through the diaphragm. In order to avoid this, when the telephone is used for conversation, it is necessary that the armature be always brought into its neutral position, and locked there. This is done by a special spring-catch, dropping a pin into a pin-hole, which arrests the armature in the proper position.

When a call is given, this pin is first drawn out of action by a cam with a milled head, which, together with the crank-handle for rotating the armature, project outside the telephone casing.

FACTS CONCERNING THE SIEMENS ELECTRIC RAILWAY OF THE YEAR 1879.

BY A. M. TANNER.

THE death of Werner Siemens has caused his inventions to be extensively reviewed by electrical and technical journals everywhere. Some of the descriptions of his electric railway at the Berlin Industrial Exposition of 1879 were not always accurate, and for this reason it is interesting at the present time to reproduce what was said by the Berlin journals at the time the railway was inaugurated. The *National Zeitung* (political), of June 8th, 1879, contains a very original account of this now classic electric railway. The style of the original German has been preserved as much as possible in the following translation, viz.:—

"A few days ago the electric railway of Siemens and Halske was opened at the Industrial Exposition. The track of this road goes through the ground of the Machinery Court in a double curve, and is endless. A train ready for departure presents a very lovely (allerliebsten) appearance. Interesting above all is the small locomotive without smoke-stack in which the engineer sits facing the rear. This locomotive has inside, the propelling electrical apparatus, the construction of which is still a secret. Three waggons are coupled to the locomotive, and each has two small benches placed back to back. Each waggon has room for eight persons. There is no difference in classes. There are no baggage waggons, and for this reason only light hand baggage can be carried along. Also there exists only one kind of train, which at pleasure can be called an ordinary, a fast, an express, or a hunting train. There are no determined times of departure. A train is started off when the waggons have been filled. The fare for each person is 20 pfennings. With this train a round trip can be made through the Machinery Court in two to three minutes. The novelty of the whole thing is readily apparent. Very often considerable time elapses before a train is started off, and the waggons remain empty, although a crowd may gather around them and the locomotive. Then all at once a resolute man comes along and takes a seat upon one of the waggon benches. Hardly has he taken his seat, when all the waggons are already filled, because at the very moment when he seats himself all the others know what to do. Then the engineer mounts his little electric horse, pulls slowly with his right hand upon an iron lever and the train rolls off. All visitors to the Exposition are advised by us not to leave the grounds until they have taken the electric rail ride in the Machinery Court. It is a pleasant and novel recreation."

It will be observed that the foregoing article does not give a technical description of the construction. A full description, however, is gathered from the *Archiv für Post und Telegraphie*, of July, 1879, in which the length of track, location of the current-producing dynamo in the machinery hall, and its connection with the track rails, and a third rail conductor is set forth at length. These track rails were not insulated from the ground, but the third rail conductor was properly insulated, and the current taken therefrom to the car motor by travelling brushes. The car wheels were not insulated, and served for the return of the current to the track rails, and from thence to the dynamo. The use of the third rail conductor is omitted in several journals which have recently reviewed the matter, and it is not accurate to say that the track rails were the going and return conductors. Naturally, Siemens had the project of an electric railway in his mind before the actual reduction to practice, and, as early as March 1st, 1879, the weekly journal of the Association of German Engineers, has a brief account of the electric railway to be inaugurated at the Berlin Industrial Exposition. The use of a generating dynamo and a circuit formed of the track and a third rail was mentioned in the journal referred to. It appears to be the first published account of Siemens's matured plans concerning an electric railway. That he had the idea of an electric railway long before, is quite evident from his own writings, and even when he submitted his paper on the dynamo to the Berlin Academy in January, 1867, he must have "dreamt," as he says himself at a later date, of the transmission of force by electricity, the reversibility of the dynamo, and electric railways, as one of the uses of the electrical transmission of force.

In settling the history of great or valuable inventions, only published descriptions and clearly established proof should be admitted in determining the date of invention.

It is not the purpose of this article to set up any one as the inventor of the modern electric railway. This appears to become more difficult every day, because, for example, an American newspaper, the *Kalamozoo Daily Telegraph*, of October 7th, 1875, contains an account of Green's electric railway, in which the arrangement of the circuit was such that the current passed from one pole of the battery to one rail through the wheels of the motor, and then passed out through the other wheels into the opposite rail, and back to the other pole of the battery.

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This railway of Green's appears to have actually existed, but it was not adapted to carry passengers, although such a use was contemplated, because the American journal referred to suggested its application for rapid transit in New York.

Whatever may be said or done in the future in determining the claims of rival claimants to the broad inventions of the modern trolley electric railway, Werner Siemens must always be considered as having proposed and constructed the first electric railway which actually conveyed passengers. It is even known through the *Norddeutsche Allgemeine Zeitung*, of October 8th, 1879, that 80,924 persons were carried in 119 days on this Berlin electric railway of the year 1879.

THE APPLICATIONS OF OZONE.

[FROM A CORRESPONDENT.]

MANY people dissert about Ozone, which has won an extremely popular name; but those who know what Ozone is, are not at all numerous; those who know how to produce it, even on a moderate scale, are very few, and those who know how to apply it are, indeed, very rare.

The fact is, that Ozone is considered as a mysterious agent, to which all sorts of marvellous properties have been attributed, about which fairy tales and legends have been told, written, and printed, even in books and publications, some of which bear a scientific name and have a certain repute.

There is perhaps more inaccuracy or untruth in the reports which tend to exaggerate the virtues of Ozone, and to represent it as the all powerful agent which serves all purposes, than there would be injustice in denying that it can render many valuable services, not only for therapeutic or sanitary purposes, but in chemistry and in several industries.

There are hundreds of uses for Ozone, said Bunsen, if only we can make it in large quantities at a low price.

Let us see what progress has been made in the manufacture of Ozone on a commercial scale, since Faraday, in 1851, made the following declarations in his lecture at the Royal Society:—

"Ozone destroys many hydrogenated gaseous compounds; the combinations of hydrogen and sulphur, selenium, phosphorus, iodine, arsenic and antimony are thus affected. It appears to unite chemically with olefiant gas, in the manner of chlorine.

"It instantly transforms the sulphurous and nitrous acids into sulphuric and nitric acids, and the sulphites and nitrites into sulphates and nitrates. It changes many metallic sulphurets (as those of lead and copper) into sulphates. Like chlorine, bromine and the metallic peroxides, it is a powerful electromotive substance.

"It decomposes many iodides in their solid and dissolved state; by its continued action, iodide of potassium becomes converted into iodate of potassa.

"It changes both crystallised and dissolved prussiate of potassa into the red salt, potash being evolved.

"It discharges vegetable colours with a chlorine-like energy.

"It produces oxidising effects upon most organic compounds, causing a variety of chemical changes; thus guaiacum is turned blue by it.

"From the above enumeration, it would appear that Ozone is a most ready and powerful oxidiser, and, in a great number of cases, acts like Thénard's peroxide of hydrogen or chlorine and bromine."

Having thus placed ozone under the auspices of so great a man as Faraday, I will, before I give the illustrated description of the principal ozonisers arranged in chronological order, which have been constructed during the last 40 years, summarise the report made by Dr. Fröhlich on the experiments he had conducted in the Siemens and Halske's works during one year and a half.

The attention paid in 1891 to ozone by the firm Siemens and Halske, is the more significant, as the late William Siemens, the illustrious electrician, was the first to construct, in 1857, an ozonising tube.

Ozone, according to Dr. Fröhlich, kills small animals, and all the insects without exception, within about 20 minutes. The only insect which apparently resists is the one which in Berlin is called *Schwabenkäfer*, a coleopter which is seen by thousands in the bakeries, the restaurants, &c. The bacteria which are in water are likewise killed by ozone, but it is still a question, up to the present unsettled, whether those in the air, and also the spores, are destroyed.

In fact, the action of ozone on impurities in water is indisputable, and when water contaminated by living organisms is ozonised and filtered, all these organisms remain in the filter.

Dr. Fröhlich did not give many details on his installation, but simply stated that 2 H.P. allowed him, in the beginning, to produce 2·4 milligrammes of Ozone per second which equals: 144 mg. per minute; 7 gr. 64 per hour, 183 gr. 36 per day of 24 hours.

He believes that the employment of Ozone will quickly become more general when it will be possible to compress it, and sell it in cylinders, as is already the case for carbonic acid and oxygen. The compression of Ozone, however, presents many difficulties; for instance, the ordinary pumps cannot be used, and besides, it is not certain at all that a strong compression would not cause the decomposition of Ozone.

Dr. Fröhlich, nevertheless, has succeeded in submitting Ozone to nine atmospheres' pressure, and there is an almost absolute certainty that this problem will be shortly satisfactorily solved.

The first known application of Ozone is *bleaching*. One can easily understand that organic colours are destroyed by Ozone, which is merely condensed oxygen. Wool, cotton, vegetable fibres, paper pulp, oils, ivory, &c., are readily bleached by it. But these properties are lessened by the action which it has on certain substances. On the other hand, the bleaching of yarns and fibres is so cheap by the ordinary processes, that, according to the German scientist, the competition will be hard. This, however, is a matter of opinion, and there is nothing in such a baseless and hazarded argument.

The improvement of wines and spirits by ozonisation has proved successful many times, and is now commercially applied in France and America. Light wines, however, cannot be ozonised, unless the operation is conducted with the greatest care, because a too long treatment would give rise to the formation of aldehydes and vinegar. The action of ozone depends principally on the qualities of the liquid; thus sometimes a very small quantity of ozone is required, and therefore the expense in ageing and refining alcoholic liquids is trifling. It has also very often been asserted that ozone acts on molasses, *clarifies sugar* and the saccharine particles which they contain to crystallise. That ozone has a very great purifying property, I admit, says Dr. Fröhlich, and nobody will deny that the syrup absorbs it entirely, and loses smell, but there is no crystallisation, and it is difficult to say whether there can be any application of ozone to that industry.

Among the physiological uses of ozone, the most important is the *purification and disinfection of air*, and of tapestry hangings in sick rooms, and in ships, but some doubts still exist on this subject, on which Dr. Fröhlich does not give his opinion, but says that we must wait until the Imperial Sanitary Board have terminated their experiments and made the question quite clear. Why has it not been the object of researches in this country? Why has not Ozone been tried for disinfecting rags used in the paper trade?

The *insecticide properties* of ozone are remarkable, and we cannot help thinking of destroying caterpillars and beetles by ozone. But the quantity of ozone to be absorbed for such a purpose is enormous, and we can hardly expect that ozone will have its effect on insects which live in the ground; and here, again, we find this difficulty, that earth, being very porous, will absorb ozone, very little of which will act on the insect.

The following interesting fact shows the energy of the influence of ozone. If you put some worms in a flower pot, and by means of a pipe pass ozone through the earth, you will see almost immediately the worms emerging at the surface.

This experiment has induced some people to try to destroy the insects which cause so much damage to vines, and to have some iron pipes in the vineyards, through which ozone was forced, so as to kill the phylloxera microbe. But this will

only be practical when ozone can be stored and compressed, and, first of all, when it will be produced and sold very cheaply. To this, I may add this personal observation that my works were infested by rats and mice, and that since I have commenced to produce ozone there they have completely disappeared.

The application which presents the best prospect of success is the *disinfection* and *sterilisation* of water.

We have made very many experiments, says Dr. Fröhlich, in Berlin, as well as in the suburbs, in view of killing bacteria in impure water, and we were completely succes-ful. The proof of the sterilisation is made by putting a few drops of the water to be worked upon into sterilised gelatine, which is afterwards carefully protected and insulated against the influence of the air. If the water contains bacteria, their culture may be seen after a few days in the form of small grains or knobs, which grow more and more. But there is no such thing to be seen in ozonised water. It remains to prove that the more ordinary bacteria, such as those of typhoid, cholera, &c., and their spores, are also killed by ozone. Only specialists can decide the important question; but so far as we can see, they are disposed to look favourably on the use of ozone.

The ozonisation of water possesses, moreover, the property of removing, or rendering innocuous, certain injurious or impure matters; finally, the bacteria which generate putridity are all killed.

We have, therefore, good ground to assert that impure water, when ozonised, is rendered drinkable and salubrious.

The *disinfection* by means of ozone possesses advantages which are not to be found in any other method of disinfection; if you compare it to the sterilisation by boiling, the disinfection by ozone is much quicker and cheaper. It presents this great superiority over the chemical disinfectants such as chlorine, sulphurous acid, &c., that it does not leave any trace in the water.

Of course, ozone is absorbed by water, but the proportion of it is so small that it can hardly be detected by the smell. Ozone passes through water, kills the bacteria, and escapes, but the solid particles in suspension in water must be eliminated by filtration.

The time will come when the question arises of the purification of impure water, such as sewage water, or water contaminated by the refuse of works, which will be treated by ozone not only with the double object of killing the bacteria and of decomposing the ammonia into its constituents, but simultaneously with the oxidation of all the organic substances in suspension. Ozone will be of great importance for the manufacture of *ferments* for *breweries*, *distilleries*, and for the preparation of *yeast*, because the great point for those industries is to get rid of injurious bacteria, to make a pure ferment and to prevent an after-fermentation.

No doubt, ozone can render valuable services in different ways. "Allow me to express my belief," added Dr. Fröhlich, in conclusion, "that there is in Ozone a new field for the electro-technic, which is already very promising indeed, and which will pay him, and of which we cannot perceive the limits."

This declaration made by the German scientist is a conclusive evidence of the possibilities of the commercial applications of Ozone. We must not forget that W. Siemens was the first to make an ozonising tube, and that if there had been nothing in the generation of Ozone, the firm Siemens and Halske would not have taken new patents all over the world and appointed Dr. Fröhlich to make, for nearly three years, in their works, experiments on the commercial production of ozone and on its uses for purifying, disinfecting, &c.

According to an American contemporary, the apparatus used by Fröhlich was built up of an inner metal tube kept cool by water and forming the inner armature. Round it was a celluloid or ebonite tube coated with a sheet of metal. Between the outer and the inner tube, in an annular space, a constant silent discharge was kept up. We shall describe in another article, and illustrate the last improvements made, by Messrs. Siemens in the construction of ozonisers.

An open circuit tranformer was used, excited by a set of accumulators, which also were driving a small motor, by the spindle of which a make and break very rapid (500 per second) was taking place in the primary circuit. This installation worked 10 tubes, and it was observed that for a few tubes the interrupted direct current gives sharper variations than an ordinary sine curve alternating one, but when there are many ozonising tubes, their increased capacity affects the former and sends its waves down to a considerable extent, while it does not affect the alternating current.

My reason for giving a few extracts of the paper by Dr. Fröhlich was to correct the erroneous statement made lately by a French electrical paper, that the conclusion to which Fröhlich had arrived was unfavourable to the applications of ozone, while it is just the reverse.

(To be continued.)

PALLADIUM PLATING.

IN 1803 the scientific world were rather exercised by a printed notice which was circulated, to the effect that a new metal called palladium, or new silver, had been discovered, and was on sale at Mr. Foster's, of Gerrard Street, Soho. The circular fully described the properties of the new metal, but Mr. Chenevix, one of the Fellows of the Royal Institute, believing from the way in which the discovery was announced, that the whole thing was a fraud, bought up the entire stock, and determined to make a thorough investigation. From the general characteristics of the metal, he formed the opinion that it was an alloy of platinum, with some other known metal, but notwithstanding most careful analysis, was unable to prove this. Baffled in his attempts to prove his point by analysis, he commenced a series of experiments to produce the metal artificially, and he ultimately published his results, and announced that he had produced it by precipitating platinum and mercury together from their solutions, and afterwards igniting them. Soon after the reading of this paper, an advertisement appeared offering a very handsome reward to anyone who would prepare artificially, even one grain of palladium, either according to Mr. Chenevix's plan, or by any other method; but notwithstanding many attempts by various chemists who repeated Mr. Chenevix's experiments, no one succeeded in obtaining the reward. In the following year Wollaston declared that he was the discoverer of palladium, and gave a detailed description of how he found the new metal when dissolving a very large quantity of platinum, but explained that he did not publish the facts before because he had not completed his research, and did not wish to draw the attention of chemists to the particular work he was then engaged upon. He had named the metal palladium, from Pallas, a new planet discovered by M. Obero in 1802.

Palladium always occurs associated with platinum, or gold ores, generally alloyed with them, but sometimes small grains of almost pure palladium are found mixed with grains of platinum from Brazil. Some gold and silver ores from South America have been known to contain as much as 10 per cent., but platinum ores more generally contain about half per cent.

The extraction of palladium from platinum is a somewhat tedious operation, as the ore has first to be dissolved in nitro-hydrochloric acid, and after the removal of the platinum by addition of ammonia salts. Cyanide of mercury is added to the solution, which throws down a white compound, which on ignition yields metallic palladium.

When alloyed with gold an entirely different process has to be used, the gold dust being first fused with an equal weight of silver, and a certain quantity of nitre, and afterwards boiled in strong nitric acid, when the palladium dissolves out with the silver and copper, the gold is left behind. The silver is then removed by adding common salt to the solution of the mixed metals, when the whole of it falls down, and is removed by filtration. The solution now contains palladium and copper, and on bars of zinc being placed in it, these metals deposit in a black powder on the bars. This powder is re-dissolved in nitric acid, ammonia and hydrochloric acid are added, when a yellow compound of palladium falls to the bottom of the liquid, which on ignition yields the metal. All the above operations have to be conducted with the greatest possible care to avoid the slightest

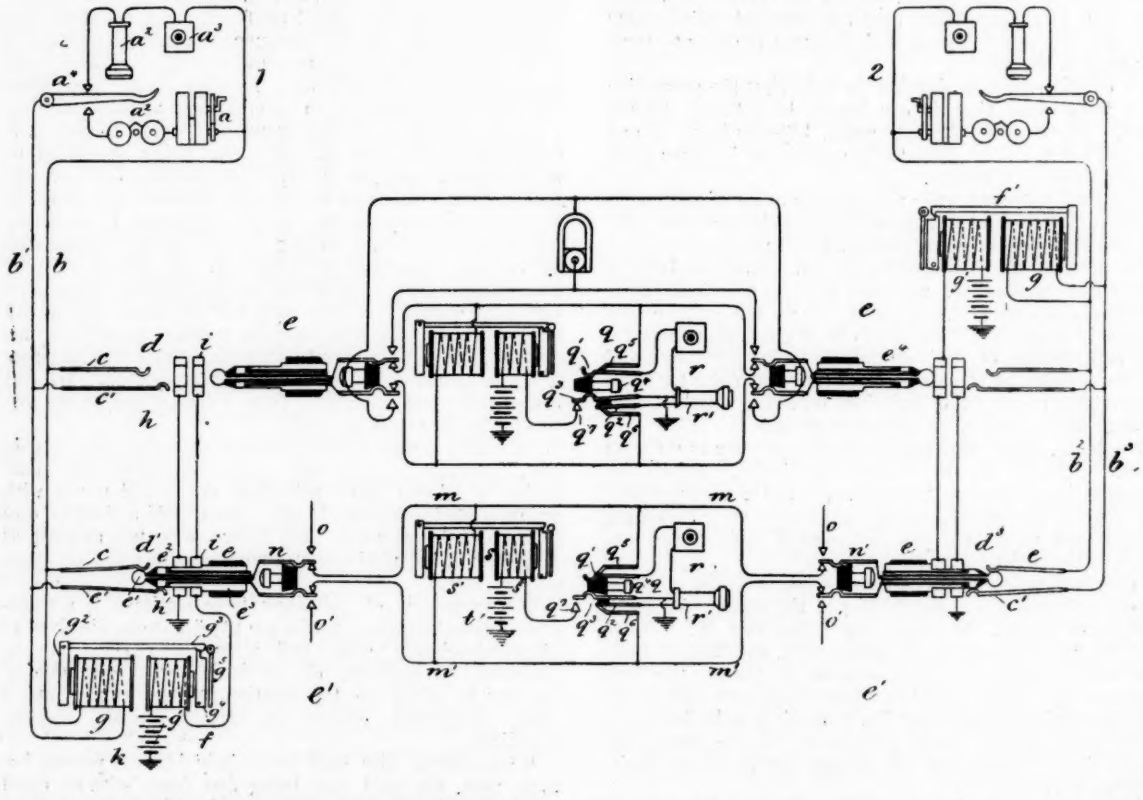
loss of these very valuable metals, and also to obtain them in a state of purity.

Palladium is a silver-white hard metal, and is sufficiently ductile to be rolled into thin leaves. It melts at an extremely high temperature, about the same as wrought iron, and when only slightly heated in hydrogen gas it has an extraordinary power of absorbing mechanically large volumes of this gas. Graham investigated this very curious phenomena, and found that a piece of palladium foil when heated below 212° F. condensed 640 times its volume of hydrogen, but that it had not the power of absorbing oxygen or nitrogen.

By far its most important characteristic is that it does not tarnish on exposure to the air, but will remain perfectly bright for an indefinite time in almost any atmosphere. This is because sulphuretted hydrogen and other sulphurous gases, which are always present to a greater or less extent in the atmospheres of large towns, have no effect whatever upon it, and consequently it does not blacken in the same way that silver does.

When alloyed with twice its weight of silver, the alloy, like pure palladium, is said to be able to resist the action of the atmosphere, and may be exposed for months and months without tarnishing. Silver palladium alloys of varying composition have been used to some extent in dentistry.

Now that difficulties connected with the electro-deposition of this metal have been practically overcome by the Arcas Plating Company, we may expect in the near future that many articles now silver plated will be coated with this beautiful metal instead, especially in cases where it is important to maintain a brilliant silver white surface for a considerable time.



AN IMPROVED TELEPHONE SWITCHBOARD SYSTEM.

IN this arrangement, which has been brought out by the Western Electric Company, the several objects are:—First, to provide circuits and mechanism whereby the individual annunciator of a line shall be automatically reset or replaced by the operation of making a connection to the line, and whereby it shall be rendered unresponsive to signalling currents during said connection; second, to provide an annunciator to respond to the signal for disconnection, and means for automatically resetting the same; third, to provide suitable means for testing at any board to determine whether a line is already in use or not; and, fourth, to avoid all connections and branches common to the different lines of the exchange.

Referring to the figs., suppose that subscriber at station 1 wishes to communicate with a subscriber at another station, as, for example, station 2. The switch, a^4, being down, the subscriber at station 1 operates his generator, a, thus sending calling current over lines, b, b^1, and through the operating coil, g, of his individual annunciator, f. The annunciator is thereby operated, and the attention of the operator is directed to the calling line. The operator then inserts a plug, as e, into the jack, d^1, of that line at her board, e^1, and depresses the plunger of her listening key, whereby her telephone is connected in a loop circuit with the lines, b, b^1. As soon as the plug, e, is inserted into the jack, d^1, the circuit of the battery, k, is closed through the restoring coil, g^1, of the annunciator, f, through the test ring, i, and contact piece, h, of the jack, d^1, to earth; and the coil, g^1, being thus energised, attracts its armature, g^4, and restores the annunciator to its original position. The operator having learned from subscriber at station 1 the number of the line with which he desires connection, proceeds to test that line by applying to the test ring at her board the tip of the other connecting plug of the pair, her telephone being still connected in the cord circuit. The plug, e^4, at board, e, is shown in the act of making such a test. In case the line tested is already in use, as the line to station 2 is in the drawing, the test rings, i, of that line are short-circuited to earth through the sleeve, e^3, and contact-pieces, h, of the jack at which connection already exists, and no effect will be produced in the telephone of the operator testing. If, however, the line were not in use, the test rings, i, of the line would be disconnected from earth, and hence a difference of potential would exist between them and the earth, due to the electromotive force of the battery, k, and a ground test plug applied to the test-ring would receive current which would cause a click in the telephone, r^1, included in circuit with it; hence an operator testing a line and perceiving a click in her telephone at each application of the testing-plug to the test-ring of the line, will conclude that the line is not in use. We will assume that the operator at board, e^1, finds line to

station 2 not in use; she then inserts the other plug, e, of her pair into the jack, d^3, of the lines to station 2 at her board, whereby the stations 1 and 2 are looped together in a continuous circuit, which may be traced as follows:—

From the telephone at station 1, by line, b, to the line spring, c, of jack, d^1, thence through the tip of plug, e, through the contacts of the ringing key, n, to tip of plug, e, to line spring, c, of jack, d^3, of line 2, thence by line, b^2, to station 2, returning over line, b^3, to line spring, c^1, of jack, d^3, thence through sleeve, e^2, of plug, e, contacts of ringing key, n^1, conductor, m^1, m^1, contacts of ringing key, n, to the sleeve, e^2, of plug, e, thence to line spring, c^1, of jack, d^1, thence returning over line, b^1, to station 1.

The operator at board, e^1, now depresses the plunger of her key, n^1, disconnecting the springs thereof from the conductors, m^1, m, and connecting them to the poles, o, o^1, of the generator, p, thereby sending a calling current to station 2, and operating the signal bell at that station.

Having ascertained that the subscribers have engaged in conversation, the operator allows the plunger, q^4, of her listening key to rise, thereby disconnecting her telephone set from the conductors, m, m^1.

When the subscribers have completed their conversation one or both of them, we will consider only subscriber at station 1 may send a clearing-out or disconnection signal; the signalling current will divide at the line springs, c, c^1, of jack, d^1, a portion passing through the operating coil, g, of annunciator, f; this annunciator will, however, not be operated, since the restoring coil, g^1, is energised, and retains the armature, g^4, preventing its movement. Another portion of the signalling current will reach the conductors, m, m^1, where it will again divide, a portion passing through the operating coil, s^2, of the clearing-out annunciator, s. The local circuit containing restoring coil, s^1, of this annunciator is open, the operator's telephone set being disconnected, and hence its armature, g^4, is unattracted and falls, indicating the disconnection signal to the operator. Another portion of the current will escape through the conductors, m, m^1, and a portion of the conductors, b^2, b^3, through the operating coil, g, of the annunciator, f, but the local circuit of its restoring magnet is also closed through the sleeve, e^3, of the connecting plug in the jack, d^3, and hence this individual annunciator also will be unresponsive.

In response to the clearing-out signal, the operator at board e^1 may again bring her telephone set r into connection with the cord strands, m, m^1, to assure herself that the conversation between the subscribers has been finished. The contact pieces, q^3, q^7, upon the key are thus closed together, completing the local circuit through the restoring coil, s^1, and restoring clearing-out annunciator to its normal position. It is not, however, necessary that the operator should connect her telephone to the lines at this stage, since she must of necessity do so when she receives another call, and will thereby reset the clearing-out annunciator of that pair of coils.

Having ascertained that the subscribers have completed their conversation, she removes the connecting plugs from the spring jacks.

The number of operations or movements which the operator is required to make in establishing and severing connection between the two subscribers and restoring the apparatus to its normal position is by this system materially reduced, the special annunciators being automatically restored to their normal positions by the act of connecting the subscribers.

Moreover, since the operator is not required to reset the annunciators manually, they may be placed above the switchboard, and the space upon the face of the switchboard which is ordinarily occupied by annunciators, may be utilised for spring jacks, thereby increasing the capacity of the switchboard.

It will be observed that when metallic circuits are employed in this system, no connections common to the different lines are required. The restoring circuits and the test circuits are wholly local, and are entirely disconnected and insulated from the line circuits.

Hanley Electric Lighting.—The Local Government Board have sanctioned the borrowing of £21,000 for electric lighting purposes.

GWYNNE'S ALTERNATING ARC LAMPS.

GWYNNE & Co., being now the proprietors of the original Pilsen patents, have quite recently adapted the Pilsen lamp for alternating current work. They have also adapted the lamp for photographic purposes where alternating currents are in use.

Fig. 1 gives a general idea of the arrangement of the lamp as used for alternating currents for ordinary illuminating purposes. The main and shunt coils are wound on separate insulating bobbins of red vulcanised fibre. The cores of laminated iron working in these coils balance each other normally and are guided by rollers having extremely little friction.

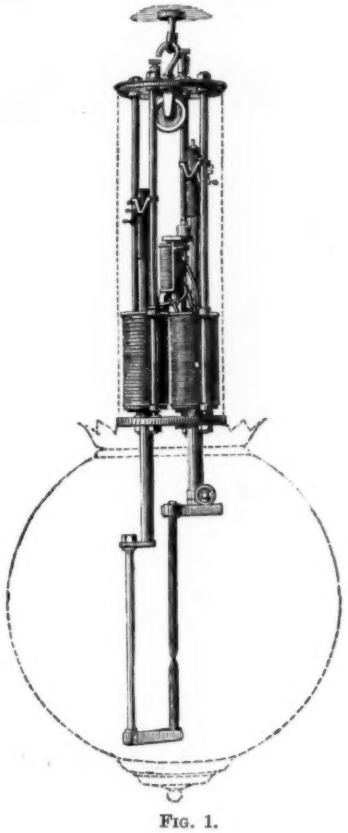


FIG. 1.

The laminated iron cores are built up of thin triangular strips of soft iron carried on a German silver central strip, thick enough to form a guide, and an attachment for the suspension and the carbon holders.

The thick wire coil acts both as a coil to part the arc and also as a choking, and the regulation of the arc is extremely quick and vigorous, while quite imperceptible; the cores are tapered in the manner usual in all Pilsen lamps.

These lamps work well in single parallel, without a resistance, with 50 volts terminal pressure and 10 to 12 ampères (virtual).

Fig. 2 is a view of the Pilsen Photographic Arc Lamp and Reflector. The lamp is very similar to the ordinary lamp described above, but is constructed with guiding wheels and counterbalance to enable it to work freely when inclined at any angle between the horizontal and perpendicular; the lamp is fitted into a very large parabolic reflector which diffuses evenly a very soft white light. The reflector and lamp are suspended or carried on a stand by universal joint, so that it can be moved into any position.

With this lamp, using 30 ampères, a photo can be taken in two to three seconds on Marion's ordinary plates with a Dallmeyer or Voigtlander lens, using a $1\frac{3}{4}$ inch stop. With 50 ampères current a photo can be taken in $1\frac{1}{2}$ seconds, using quick plates.

The lamp is made to run with any frequency of current used in the ordinary distribution systems.

A lamp specially designed for printing from photographic

negatives has also been brought out by Messrs. Gwynne and Co. It consists of a Pilsen lamp in a particular reflector, which concentrates most of the light of the arc with a circle of about 7 to 8 feet on a horizontal table. Within this circle the negatives are laid.

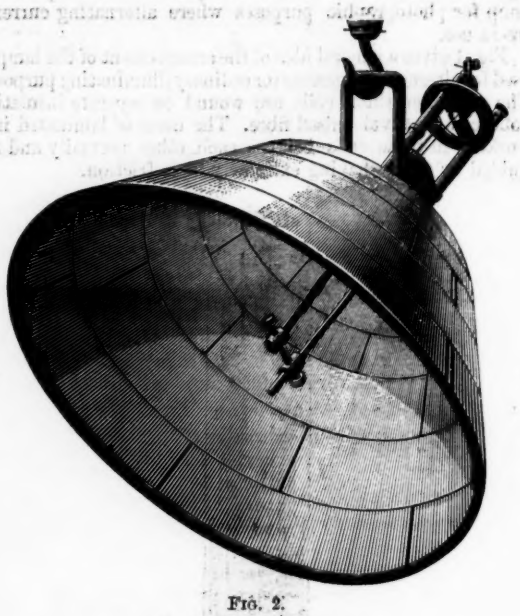


FIG. 2.

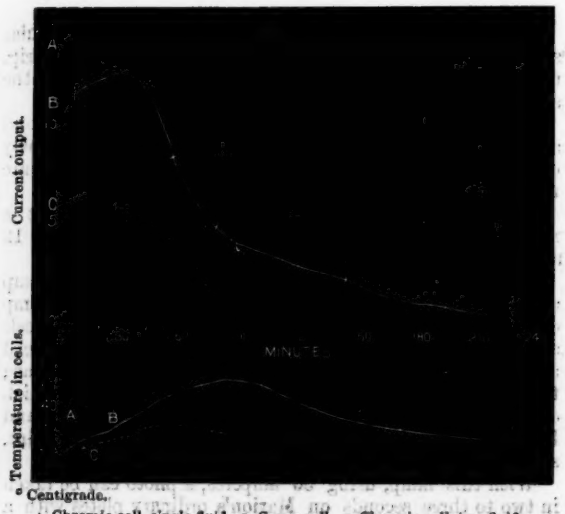
Using a current of 30 amperes, prints can be made in 20 to 30 minutes, and four or five dozen can be done at one time.

These lamps are made to work on either continuous or alternating currents.

HEATING IN VOLTAIC CELLS.

BY T. H. MURAS.

THE annexed curves show the current output and temperatures of small chromic acid and Grove cells discharging continuously through a circuit of ·06 ohm external resistance.



A, Chromic cell, single fluid; B, Grove cell C, Chromic cell, two fluids.

VOLTAIC CELLS ON SHORT-CIRCUITS.

The cell used was rectangular, approximately 13 × 8 × 4½ cm. inside, and contained one platinum plate having a total immersed surface of 104 sq. cm., and two well amalgamated cast zinc plates. The inner surfaces of both zincs amounted to 103 sq. cm. in the chromic cells, and 125 sq. cm. in the Grove cell. A dry red porous pot was used in each two-fluid cell. The solutions were made from the strong common acids sold by chemical dealers, the proportions being as follows :—

Cell.	Chromic acid. Grms.	Sulphuric acid. c.c.	Nitric acid. c.c.	Water. c.c.
A. Chromic, single-fluid..,	28·4	49·7	...	227·2
B. Grove, inner cell ...	...	...	50	...
„ outer cell ...	...	25	...	145
C. Chromic, two-fluid,				
inner cell ...	14·2	14·2	...	56·8
outer cell ...	...	21·3	...	170·4

The temperatures were taken with a thermometer having its bulb near the top of the outer cell when using chromic acid, and about half-way down the outer cell of the Grove combination. The lower parts of the cells were somewhat cooler. The air temperature was about 12° C. in the chromic acid experiments, and 18° C. in the other.

The following additional particulars may be interesting :—

A. *Chromic Single-Fluid Cell.*—Difference of potential of terminals before start, 1·83 true volts ; after 17 minutes, ·07 volts. On opening the circuit after 17 minutes a quantity of gas was given off, and on stirring, the P.D. rose to 1·64 volts, more current being then obtained for a minute or two only. The P.D. was measured in a circuit of 8,200 ohms resistance, the standard being a Clark cell. The internal resistance of the cell at starting was ·07 ohm, as calculated from the P.D. and current, which may be approximately correct if the polarisation was small. The current efficiency of the cell for 17 minutes was 17·3 per cent., as found by comparing the number of ampère minutes shown by the curve with the number calculated from the quantity of chromic acid used.

B. *Grove Cell.*—The P.D. was measured at several times marked on the current curve, the main circuit of the cell being opened for this purpose for a minute each time. Time so occupied is not included in the times stated on the diagram. The P.D. was found to be steady at each time. The nitric acid was completely exhausted at the end of the experiment. The current efficiency is calculated relatively to the quantity of nitric acid used.

Minutes from start.	P.D.	Internal resistance (calculated).	Current efficiency, per cent.
0	1·97	·125	...
55	1·80	·16	...
64	...	...	64·2
76	1·80	·30	...
112	...	...	81·6
142	1·71	·74	...
184	...	...	93·7

C. *Chromic Two-fluid Cell.*—Before start, P.D. = 1·81 volt, internal resistance = ·27 ohm. After finish, P.D. = 1·70 volt, internal resistance = 1·07 ohm. Current efficiency for first 40 minutes, 39·6 per cent. ; for 80 minutes, 59 per cent.

The measurement of P.D. with the main circuit open is unsatisfactory, as it affords no direct information as to the E.M.F. when the circuit is closed. It should be possible to measure the combined resistance of the cell and external circuit in parallel by the alternating-current method, during the passage of the main current. The external resistance and current being known, the internal resistance and E.M.F. of the cell could then be calculated. This method would necessitate the use of a circuit of imperceptible capacity and self-induction.

It appears probable that the increase of the current after starting is due to diminution in resistance of the liquid owing to its rise in temperature, before its composition has changed greatly.

ST. PANCRAS ELECTRIC LIGHTING.

THE following is a statement of accounts at December 31st, 1892, issued by Mr. Thos. Eccleston Gibb, Vestry Clerk, under the St. Pancras Electric Lighting Order, 1883, showing the result of the year's working:—

CAPITAL ACCOUNT at December 31st, 1892.

Dr.	£	s.	d.
To Lands, including law charges incidental to acquisition	10,827	0	0
„ Buildings and paving	7,653	17	8
„ Machinery and plant	24,378	17	1
„ Accumulators at generating and distributing stations	2,961	6	11
„ Mains, including cost of laying the mains and services and royalties	33,787	15	3
„ Public lamps	6,723	8	4
„ Meters fixed on installations	1,556	3	9
„ Electrical instruments, &c.	284	16	3
„ Office and other furniture and fittings	186	7	4
„ Preliminary expenses	554	4	7
Total expenditure	88,913	17	2
To balance of capital account	2,355	13	7
	£91,269	10	9

Cr.	£	s.	d.
By Amount raised by loans	70,000	0	0
„ Temporary loans from bank	21,269	10	9
	£91,269	10	9

REVENUE ACCOUNT at December 31st, 1892.

Dr.	£	s.	d.
To Generation of electricity—To coals or other fuel, including dues, carriage, unloading, storing, and all expenses of placing the same on the works, £3,010 17s. 8d.; to oil, waste, water, and engine room stores, £433 18s. 7d.; to wages at generating station, £1,983 12s. 7d.; to sundry petty expenses, £44 17s.; to repairs and maintenance as follows: buildings, £2 13s. 2d.; engines and boilers, £209 5s. 6d.; dynamos, exciters, accumulators, &c., £42 11s. 5d.; other machinery, instruments and tools, £8 7s. 8d. = £262 17s. 9d.; less received for old material, £1 2s. 6d. = £261 15s. 3d.	5,735	1	1
„ Royalties, &c.—To licenses for mains laid on Crown property	24	11	5
„ Management expenses—To salaries, viz.: Engineers' department and clerical staff, £812 6s. 11d.; to stationery and printing, £276 10s. 7d.; to general establishment charges, £232 14s. 3d. =	1,321	11	9
„ Distribution of electricity—To wages and other remuneration to linemen, fitters, labourers, £281 2s. 9d.; to repairs, maintenance, and renewals of mains of all classes, including materials and laying the same, £20 16s. 2d.; to repairs, maintenance, and renewals of meters, switches, fuses, and other apparatus on consumers' premises, £8 7s. 11d.; to gas and water at sub-station, £16 15s. =	327	1	10
„ Public lamps—To carbons, £154 11s. 7d.; to attending, £191 0s. 1d.; to repairs, £13 12s. 6d. =	359	4	2
„ Law and parliamentary charges—To law expenses, £228 1s.; to parliamentary charges, £163 16s. 4d. =	391	17	4
„ Special charges—To insurances, £79 12s. 9d.; to expenses fixing meters, &c., on consumers' premises, £188 8s. 2d. =	268	0	11
Total expenditure	£8,427	8	6
Balance carried to net revenue account	2,575	14	0
	£11,003	2	6

Cr.	£	s.	d.
By Sale of current per meter at 3d. and 6d. per B.T.U.	8,167	7	8
„ Public lighting	2,040	8	0
„ Rental of meters and other apparatus on consumer's premises	152	12	11
„ Rents from houses on spare land	426	14	9
„ Work on consumer's premises	195	19	8
„ Sale of lectures and reports	19	19	6
	£11,003	2	6

NET REVENUE ACCOUNT.

Dr.	£	s.	d.
To Interest on mortgage debt accrued due to date	2,817	11	7
„ „ bank temporary loan	901	8	7
„ Instalments of principal of money borrowed	400	0	0
	£4,119	0	2

Cr.	£	s.	d
By Balance brought from Revenue Account	2,575	14	0
„ „ carried forward	1,543	6	2
	£4,119	0	2

GENERAL BALANCE SHEET.

LIABILITIES.

Dr.	£	s.	d.
To Capital account—Amount received as per Account	91,269	10	9
„ Amount due to contractors	3,075	3	9
„ Sundry creditors	1,195	3	4
„ Interest accrued on loans	994	8	9
	£96,534	6	7

ASSETS.

Cr.	£	s.	d.
By Capital account—Amount expended for works	88,913	17	2
„ Stores on hand at December 31st, 1892:—Coal, £130; oils, waste, &c., £32 3s. 5d.; general, £848 5s. 9d.	1,010	9	2
„ Sundry debtors for current supplied to December 31st, 1892	5,045	1	0
„ Cash in hand	21	13	1
„ Net revenue account	1,543	6	2
	£96,534	6	7

THOS. ECCLESTON GIBB, *Vestry Clerk.*

February 1st, 1893.

WILLIAM WALLACE.

THE February numbers of the *Electrical Engineer*, of New York, contain an interesting biography of an electrician described as "the highest type of our American manufacturer," who justly has a right to figure among the distinguished pioneers of electric lighting enterprise.

William Wallace was born in Manchester, England, March 16th, 1825, and was taken by his parents to America in 1832. He appears to have started as a pin maker and wire drawer, and, from a very small beginning, to have developed a large manufacturing business in metal work. The factory, of course, now possesses the largest and tallest chimney-stack in the State—it is remarkable how many big chimneys there are of the kind, even in England.

The Wallace-Farmer dynamo is, perhaps, the best known of this distinguished American's inventions on this side of the Atlantic. His biographer gives him the credit of having been the first builder of dynamos in America, and the first manufacturer in that country to apply the dynamo to the art of electro-plating. His earliest machine consisted of a simple horse-shoe electro-magnet, inverted, between the poles of which revolved an armature of the Gramme type, the ring being quite broad. This dynamo is remarkably like the Edison dynamo turned upside down, and, except for mechanical strength, it does not appear to possess any great points of originality beyond those which were at that time fairly well known throughout the world. Another dynamo, designed about 1875, was termed by Mr. Wallace the "Telemachon," and was described as being "for the development of power at a distance from its source." At a speed of 1,000 revolutions this machine supplied eleven arc lamps, when driven by a 1¼-inch belt, the pulleys being 8 inches in diameter. The record does not describe the arc lamps, so that the statement is a little vague. This machine contained a Gramme armature, and the most interesting fact connected with it is that it was the first armature in which laminated plates of iron were used. Mr. Wallace says: "In those days we knew nothing of hysteresis, eddy currents, or Foucault currents, but I was aware that there was a loss caused by what I termed 'interference of magnetism,' and made the core of iron plates twelve in number, separated by shellaced paper, to obviate this difficulty. My experiments in building induction coils suggested my breaking up or laminating the iron core."

Mr. Wallace was fortunate enough to be numbered among

the first who heard the electrical transmission of articulate speech. He describes the incident thus :—"To ensure quiet, Sunday afternoon was selected. The day was exceedingly warm, and after repeated failures, the crowd had grown very restless and impatient, and Sir William Thomson came to Prof. Barker several times saying, "This is sheer nonsense." Presently, says Mr. Wallace, Sir William went to the other end of the line, and Mr. Bell, who had been nervously working over his apparatus, requested Dom Pedro, the Emperor of Brazil, who was among the party, to take the telephone and listen. "Do you hear anything, your Excellency?" he enquired, "Yes," the white-haired old *savant* tremblingly replied, beads of perspiration standing out on his brow, and his eyes gleaming with nervous excitement, "I hear, 'To be, or not to be, that is the question.'" This message, sent over the line by Sir William Thomson, was the first public message sent by telephone, and the scene, Mr. Wallace says, left an indelible impression on his mind, and on that of all others who were gathered there. We wonder whether these weird, tragic words remained in the mind of the unfortunate emperor, Dom Pedro of Brazil, when, some few years afterwards, he saw his kingdom vanish.

REVIEW.

Dynamo Machinery. By Dr. JOHN HOPKINSON. London: Whittaker & Co.

The author of this work has from time to time during the past ten years contributed to the learned societies original papers dealing with "Electric Lighting," "The Characteristic Curves of Dynamos," "Theory of the Alternator," "Working Alternators in Parallel," dealing also with the subject of "Lighthouses." These papers are well known and often referred to by engineers, and have been of great value to the electrician engaged in the practical work. The book before us consists of these papers, somewhat extended, corrected and rearranged. In this handy form the papers are now easily within the reach of every one, and must prove of great value to the student and young engineer.

The author in making his papers into book form, hopes thereby to bring his work more readily before American electricians. In this he will not be disappointed; a book of this class is always taken up with avidity in America; its originality appeals to them strongly, possibly because of the rarety of originality in papers and books now so plentifully published. One feels after a perusal of the papers that in book form they might have been expanded considerably. As it is the book ought to be studied by all those students of electrical engineering who have not gone through the original papers. A thorough understanding of the papers on dynamos forms an excellent foundation for a sound knowledge of that machine.

NOTES.

Hammersmith Electric Lighting.—The Hammersmith Vestry have given permission to the Electric Light Committee to expend £100 in making experiments for the purpose of utilising the dust and house refuse to produce heat for electric lighting purposes.

Powderhall Electric Lighting.—On Saturday last a subcommittee of the Cleaning and Lighting Committee of the Edinburgh Town Council had before them the question of providing electric light at the destructor premises at Powderhall, and also supplying a certain area in the immediate district of the buildings. After consideration it was resolved to ask Mr. Murray, B.Sc., for a report on the whole subject.

Sandgate Electric Lighting. — Negotiations are pending with the South Eastern Railway for the supply of electric power to the tramway between Sandgate and Hythe. It is proposed to utilise the same power to illuminate the parade from Sandgate and Seabrook to Hythe.

St. Helen's Electric Lighting.—The surveyor has prepared a very interesting report on the lighting of the Town Hall and Offices for 81 days, which is the period the buildings have been lighted by electricity. In making his calculations, he asserts that the total run of the lamps has been equivalent to 99,239 actual lamp hours = 5,837 units used. The cost of generating this has been as follows :—

Wages	£16 16s. or ·70d.	per unit.
Coal, 54 tons, 18 cwt., 3 qrs., at 14s. 2d. per ton, equals ...	£38 18s. 3d. or 1·60d.	„
Renewal of lamps, 46 at 3s. 6d., equals	£8 12s. 6d. or ·35d.	„
Oil, waste, &c.	£7 19s. 1d. or ·32d.	„
Interest on £1,500 for 3 months, at 3½ per cent. (£1,434 19s. 6d. of which has been spent) ...	£12 3s. 9d. or ·50d.	„

These figures, he continues, are equal to 2s. 11d. per 1,000 feet of gas. There have also since been several additional expenses. A comparison of the respective costs of gas and electricity shows that the electric light in these buildings has cost £47 14s. 9d. more than the amount previously charged for gas. The number of lights, however, and the C.P. have been materially increased, now that electricity is used, and a larger quantity of artificial light has also been needed during the period referred to than is usually the case.

Société Internationale des Electriciens.—At the last sitting of this society, February 1st, 1893, M. J. Carpentier presiding, M. F. Géraldy offered some suggestions with regard to insulators. He gave the results of M. Hess's experiments, in which two parts of a condenser are considered, one formed of insulating material and the other of conducting material. The facts obtained verify the interesting hypotheses, published by Maxwell and Clausius, with regard to heterogeneous bodies. All these results have already been published in *La Lumière Electrique*, and it is not, therefore, necessary to refer to them. M. R. Picou then spoke of the advantages afforded to central stations by establishing conductors directly with the earth. The putting to earth of the negative wire in a two-wire distribution enables electrolytic action to be avoided. In a three-wire distribution, it is generally the neutral wire which is in connection with the earth. Nothing has as yet been decided with regard to the putting to earth of alternating current circuits.

More Popp Company Accidents.—Two accidents have just happened in Paris, one after the other, to the Popp Company's property. On January 18th, a compressed air pipe burst in the Rue de Caire. A hissing noise ensued which lasted a considerable time. On January 29th, in consequence, of an escape in the compressed air pipes, the Buen Retiro station was not able to supply the circuits of the Rue Royale, the Place de la Madeleine and the Boulevard de la Madeleine. Thus the arc lamps in these streets were extinguished for several hours.

Norwich Electric Lighting.—The Norwich Electricity Company, Limited, have decided to adopt a new system of charging for electricity, which will, in future, be supplied at half-price during the day and night, excepting from one hour before sunset until 8 o'clock in the evening. The price will thus be reduced to 4d. per Board of Trade unit for the greater part of the day and night, and will remain at 8d. per unit, as hitherto, for the short period named above.

An Electrical Furnace.—M. Moissan has just succeeded in producing the diamond artificially, by means of the electric arc. Under certain conditions, he obtains a hard body, the density of which is 3·5, formed like the ruby, and giving off carbonic acid while burning. This result is obtained by subjecting to the electric arc some cast-iron or silver, and saturating it with carbon. The arc is formed between two carbons placed in a groove on a block of quicklime, and covered with another block. The arc at this moment expends 70 volts and 450 ampères, or 31,500 kilowatts; its temperature is 3,000°. Care must be taken to cool the crucible quickly; a hollow is then formed, inside which great pressure is developed. This discovery created great interest at the Académie des Sciences on the day when it was presented, February 6th, 1893.

The Sector of the Champs Elysées, Paris.—The sector of the Champs Elysées has been working for some little time. The mains now laid supply about 6,000 16 candle-power incandescence lamps. The official opening of the works will probably take place at the end of the month; we shall then be in a position to give a description of this new installation.

Cable Interruptions.—The Eastern Telegraph Company announces that telegraphic communication with South Africa is totally stopped, owing to the almost simultaneous interruption of the St. Thome-Loanda and Aden-Zanzibar cables. Repairing ships are close at hand in both cases, and communication is expected to be restored very shortly.

Ealing Electric Lighting.—Messrs. Bramwell and Harris have presented their report as to the best method of electric lighting Ealing.

Yarmouth Electric Lighting.—The Council at their next meeting will consider a resolution to rescind the decision arrived at some time ago, to carry out public electric lighting in the borough.

Proper Use of Terms.—We often notice, says the New York *Electrical World*, especially in papers written by mechanical, civil and other engineers who are not electricians, that they use electrical terms incorrectly. We refer at present more particularly to the loose way in which the terms kilowatt and kilowatt-hour are used. A kilowatt is a unit of power or activity, and includes the element of time. On the other hand a kilowatt-hour is a unit of work or energy, and is as a unit entirely independent of the element of time: it is precisely like the terms foot-pounds, or horse-power hour, or joule, into which it is directly convertible.

Telegraph Breakdown.—A rather serious case of damage occurred to the main East Coast line of the Postal Telegraph system on Monday, last week. This line passes in its journey to the North through Hatfield. On the day named a party of workmen, cutting trees near Hatfield, and close to the line of wires, allowed a large and heavy branch to fall across a span. It broke all the wires at the point where it fell, and also snapped four and six of the wires respectively in the two adjacent spans. The Department's sectional engineer, Mr. Parkinson, was at Welwyn at the time, and got intimation of the breakdown at 1 p.m. He secured a local lineman and some line stores, and at once drove to the scene of the disaster, ten miles distant, reaching there at 2.50 p.m. By 3.15 they got three wires through, and by 4.10 all 20 wires were again working. This is considered rather a feat in patching a telegraph line. Prompt action was specially desirable on Monday, for it enabled this important line to bear its share in the great work of conveying the details of Mr. Gladstone's Home Rule scheme to the different parts of the country that evening.

Barry Electric Tramway.—The Parliamentary Committee of the Barry and Cadoxton Local Board have determined not to offer any opposition to the Barry Railway Company's Bill in Parliament for a new dock, electric railway and extension of the present railway system.

North East Coast Institution of Engineers and Shipbuilders.—On Tuesday last a paper, illustrated by practical experiments, was read by L. Newitt on "Ship's Electrical Fittings for Lighting, Signalling, Telegraphing, &c."

Curious but Successful Treatment.—Under this heading *The Natal Advertiser*, apparently in good faith, recounts the curative treatment to which a man who had been struck by lightning was subjected. The account states, "Brandy was administered internally, after which he (the injured man) was able to speak. He was put to bed, while Mr. Walter Stead procured some copper wire, which was utilised as a conductor from the injured man's body out of the window into the ground, and by means of which he obtained speedy relief. We are glad to state that Mr. Stead has now almost completely recovered from the shock. Great credit is due to Mr. Walter Stead for the prompt and effectual manner in which he treated the case."

Church Electric Lighting.—In the Italian Church (Roman Catholic), Hatton Garden, the electric light has just been introduced.

Earthed Returns for Electric Railways.—It is questionable, says *Industries*, whether earthed returns will not have to be abandoned for tramway and railway work. If the conductors are earthed, there must be electrolysis and there must be corrosion, and this means heavy depreciation and cost of repairs. In a long line there may be many volts drop along the return conductor, and this means considerable leakage current, and leakage current cannot exist without its corresponding electric corrosion.

Leith Electric Lighting.—The Town Council, after expending much money on deputations to other towns, &c., have now come to the conclusion that it is not wise for them as a corporation to undertake the supplying of electricity to the public in face of their connection and agreements with the Gas Commission. It has been resolved to remit to the Lord Provost's Committee to consider and report as to whether the powers under the Electric Lighting Provisional Order, 1891, should be transferred to the Edinburgh and Leith Town Commissioners.

Maidstone Electric Lighting.—The Corporation, after considering Mr. Hawtayne's report, have decided that they are not justified in carrying out the scheme; but they have given instructions for information to be ascertained as to the terms on which a company will undertake to carry out the order, "having special regard to the maximum cost to the consumers, and the time for which a contract would run."

Chicago Exhibition.—The secretary of the Polytechnic Institute has forwarded us particulars of their co-operative excursions to the World's Fair, and also to the Norwegian Fiords during the approaching summer.

Leicester Electric Lighting.—A special meeting of the Town Council was held last Monday, when a committee's report was presented on the subject of electric lighting the borough. It is recommended that the Brush Company's scheme and tender, at the sum of £26,977, be accepted. This figure does not, of course, include the cost of building. It is proposed to apply for powers to borrow £50,000. The engineer, Mr. A. Colson, C.E., has also prepared and presented an exhaustive report on the various schemes and tenders submitted. He states that were the works commenced at once, they could be completed some time during next winter.

Wakefield Electric Lighting.—A paper by W. Tunnicliffe on "The Economical Consumption of Coal," was read before the Wakefield Paxton Society recently. Mr. Tunnicliffe brought his remarks to bear upon the electric lighting of Wakefield.

Reduction in Price per Unit.—We understand that the City of London Electric Lighting Company, Limited, intend making a reduction in the charges for electricity to 4d. per unit for certain purposes, but not a general reduction.

Henley Electric Lighting.—The Town Council intend applying for a Provisional Order.

Crystal Palace Electrical Exhibition.—The half-yearly report of the directors of the Crystal Palace Company contains the following paragraph regarding last year's electrical exhibition:—"The company were committed to the opening of the Electrical Exhibition on January 1st, 1892, but within a fortnight of that time a sad event happened, which cast a gloom over the entire nation. The year, moreover, had been remarkable for the prevalence of influenza and fog. From a scientific point of view, the Electrical Exhibition had been an enormous success, but from a financial point of view it had been an enormous failure. Their receipts had, in fact, been £8,000 less than in the year of the last Handel Festival, 1891. Besides that, the Exhibition blocked up their space, and they were therefore unable to hold other shows."

Lectures.—Last week Dr. Joseph M'Grath lectured at the Dublin Catholic Club, on "The Electric Current and its Effects."

The Rev. Alex. C. Henderson, Dundee, gave a lantern lecture on "Electricity," before the Arbroath Young Men's Guild, last week.

Last Monday evening an interesting lecture was given in the Circus Street Hall, Nottingham, by Mr. Samuel Vyle (chief electrician to the colony of British Guiana), on "The Development of the Electric Telegraph." The lecture was illustrated by apparatus lent by Mr. W. H. Preece.

Publishing by Telephone.—A copy of the first so-called "Telephonic Newspaper" appeared in Buda Pesth last Monday, says the *Standard* Vienna correspondent. In other words, the latest items of news—political, local, commercial, sporting, and other—are sent out from a central office by telephone to the subscribers, who, for this intelligence, pay the very modest sum of only some three shillings a month. This novel undertaking comprises at its central office two departments—a regular editorial office, which receives the telegraphic and oral messages, and works them up into leaders or paragraphs; and a special telephonic publishing department, where experienced speakers, each possessing a soft but distinct voice, transmit through the instruments the contents of the manuscripts delivered from hour to hour by the first department. There are two languages used, German and Hungarian, and financial articles, reports of theatrical performances, book reviews, and paragraphs on all the miscellaneous topics found in a daily newspaper. The subscribers who receive the news have a square wooden tablet before them, from which are suspended two tubes long enough to reach their ears when they are sitting in an easy chair or at a writing desk, or even when lying in bed. The service commences at eight o'clock in the morning, and lasts till nine in the evening. The novelty has, so far, been very well received in the Hungarian capital.

Electric Railway Bills in Parliament.—The Clapham Junction and Paddington Railway Bill will be opposed by the London County Council, the London and South-Western Railway Company, the Metropolitan Railway Company, the Metropolitan District Railway Company, the Conservators of the River Thames, and the National Telephone Company. Petitions on behalf of each of the above public bodies have been deposited at the Private Bill Office of the House of Commons, praying to be heard by counsel against the measure. The opposition to the Edgware Road and Victoria Railway Bill has greatly increased in volume. Lord Iveagh, the Duke of Westminster, the President of St. George's Hospital, the Metropolitan District Railway Company and Metropolitan Railway Company, owners of property in Edgware Road, the London County Council, owners of property near the line of the proposed railway, the Aerated Bread Company, and owners, &c., in Grosvenor Place and Grosvenor Gardens, have severally petitioned Parliament to be allowed to be heard by counsel against the scheme.

Electric Light Consumers and High Pressure Currents.—There is no doubt that the public are to a great extent prejudiced against high-pressure currents. It becomes, therefore, the duty of a high-pressure company to combat these fears throughout its area of supply. We are glad to note that the London Electric Supply Corporation are taking the public into their confidence and are issuing circulars which, by means of remarkably clear drawings, ought to convince the public that the system, when properly arranged and controlled, is equally as safe as the low-pressure system.

Electro-Harmonic Society.—There is to be a ladies' evening in connection with this Society, to-night, at the St. James's Hall Restaurant (Banquet Room), Regent Street, W.C. The artistes are:—Vocalists, Madame Isabel George and Mr. Charles Chilley; solo violin, Mr. T. E. Gatehouse. There will also be an orchestra, an instrumental quartette, and humerous selections.

Newcastle Electric Lighting.—At a recent meeting of the City Lighting Committee of the Corporation, a deputation of merchants in Grey Street was received and heard with regard to the better lighting of that thoroughfare. They acknowledged recent improvements, but suggested electric lighting. Subsequently, in discussing the better illumination of the city, it was agreed that a special meeting be held to consider the advisability of the Corporation taking up the electric lighting on its own account.

Gas Explosion. — On Wednesday last, in the Lord Mayor's Court, an action was brought against the Gas Light and Coke Company, Limited, to recover damages for injuries alleged to have been caused through an explosion of gas, said to have arisen through the negligence of the defendants. The plaintiff, a warehouseman, said that on October 14th he was in Great Tower Street, standing on a "box" in the pavement which was used for regulating the electric light, when an explosion of gas suddenly took place, and he was thrown a few feet in the air and fell with some violence to the ground. The negligence alleged was that there was an escape of gas from the main, and that workmen in digging struck some stones, which emitted sparks and thus ignited the gas. The defence was that the electric light box became filled with gas, and that the electric light ignited it. It was further stated that the electric light "boxes" were sources of great danger to the public, because they became receptacles of stray gas. The jury found for the plaintiff for £40.

Berwick Electric Lighting.—The Lighting Committee have in preparation a scheme of electric lighting for the borough.

Alkaline Ferricyanides by Electrolysis. — The Deutsche Gold und Silber-Scheideanstalt, of Frankfort-on-the-Main, are now exploiting a new commercial process for producing alkaline ferricyanide, &c., by means of electrolysis. It appears that when red prussiate of potash, for example, is manufactured by the oxidation of the corresponding ferro-salt by treatment with chlorine or bromine, the ferri-salt is obtained contaminated by the bromides or chlorides which pass into solution with it; or, when an electric current is used for effecting the oxidation, that caustic alkali is formed and renders the resulting ferricyanide impure. This difficulty it appears has now been obviated by conducting the oxidation in the presence of an alkaline earth salt such as calcium ferrocyanide; the oxidation may be by means of bromine or chlorine, but electrolysis appears to give the most satisfactory results.

Electro-Deposition on Glass, &c.—Another improved process for the electro-deposition of metal upon the surface of glass, porcelain, china, earthenware, &c., is now being worked in Paris. It is the invention of Mons. H. Pottier. Recognising the difficulty of obtaining a satisfactory metallic coating by direct electro-deposition, he applies to the surface of the article that is to be decorated a paste composed of finely divided silver, plumbic borate and oil. The article is then heated in a muffle furnace to a moderately high temperature, with the result that a strongly adherent film is produced which possesses high conductivity. The electro-deposition can then be performed with great facility, and the resulting coating is stated to be most satisfactory.

New Data Concerning Electrolytic Gas.—In a recent research which had for its main object the determination of the atomic weight of oxygen, Mons. A. Leduc, found certain data respecting electrolytic gas, which may be usefully recorded. Special precautions were taken to ensure the purity of the gas, which was made by passing a current of 5 amperes between platinum electrodes, immersed in a 30 per cent. aqueous solution of potash for several days under constant conditions of temperature and pressure. He found the specific gravity of electrolytic gas referred to air to be 0·41423: with a maximum error of 1 in 10,000. Taking the specific gravity of hydrogen as 0·06947, and that of oxygen as 1·10503, electrolytic gas must contain 66·708 per cent. of hydrogen and 33·292 per cent. of oxygen by volume, so that the ratio of hydrogen and oxygen is 2·0037 : 1.

Magnetic Properties at Different Temperatures.—The magnetic properties of certain diamagnetic substances at various temperatures have recently formed the subject of an investigation by Mons. P. Curie (*vide Comptes Rendus*, Vol. cxvi., No. 4, p. 136—139). Amongst these substances we notice bismuth, antimony, phosphorus water, quartz, sulphur, selenium, tellurium, bromine, iodine, palladium, oxygen, water and the chloride, sulphate and nitrate of potassium. None of these exhibits any perceptible effect of residual magnetisation, and the coefficient of magnetisation is constant for every temperature, whatever may be the intensity of the magnetic field between the limits 50 and 1,350 C.G.S. units. In the paper in which Mons. Curie has recently described his investigation, tables are given for the values of the coefficients, some of which differ from those obtained by Ettinghausen, and by Boys. Some of these results are specially interesting. The coefficient of sulphur is the same for all the allotropic conditions which it is capable of assuming; red and yellow phosphorus, however, present some differences, as also does antimony, according as it is of the ordinary kind, or is produced electrolytically. Bismuth was very completely studied by Mons. Curie, and the results obtained with this substance are plotted in a very curious curve. The results of the whole research place the diamagnetic and the magnetic substances in strong contrast.

NEW COMPANIES REGISTERED.

George Moritz, Limited (38,158).—This company was registered on the 9th inst. with a capital of £5,000 in £1 shares, to acquire the goodwill of the business of an electrical engineer, dealer in electrical appliances, fittings and instruments, now carried on by G. Moritz, under the style of "The Manchester and Liverpool Electric Engineering Company," at Liverpool and elsewhere; and to carry on the business of electrical and mechanical engineers, manufacturers of electric, magnetic, telegraphic and other appliances in connection therewith, to buy, sell, manufacture and deal in oils, tallows, colours, candles, ironmongery and chemicals, and to carry on the business of dealers in foreign and English produce—drysalters and other similar trades. The subscribers (with one share each) are: J. Heap, 12, Cretney Street, Hulme, solicitor's clerk; M. Wise, Manchester, solicitor; F. Myers, Manchester, solicitor; J. Scott, 83, Trescot Road, St. Helens, clerk; A. R. Porett, Manchester, valuer; A. Stonex, Besses, Manchester, accountant; K. Rigby, 36, Deansgate, Manchester, engineer. Registered without articles of association by Jordan & Sons, 120, Chancery Lane, W.C. Registered office, 40A, Lancaster Avenue, Fenwell Street, Manchester.

Crown Contract and Works Company, Limited (38,210).—This company was registered on the 16th inst. with a capital of £10,000 in £1 shares, to construct, execute, repair and maintain, in any part of the world, railways, tramways, harbours, docks, water works, gas works, telegraph, electric works, or for the supply or use and application of electricity, electric light or power, and other public and private works or buildings; to construct, supply and maintain, rolling stock, horses, machinery, apparatus and other things for the working and carrying on of any of the businesses referred to, and to enter into and adopt any contracts in relation to these matters. The subscribers (with one share each) are:—F. C. Moon, 66, Bramah Road, Brixton, secretary; R. A. Hose, 2, Finsbury Circus, E.C., gentleman; C. D. Waller, 3, Great Winchester Street, E.C., merchant; H. R. Trehearne, 57, Moorgate Street, E.C., contractor; G. E. Moofin, 3, Holderly Road, Brockley, S.E., gentleman; G. Austin, Telegraph Street, E.C., gentleman; H. S. Trehearne, 57, Moorgate Street, E.C., advertising contractor. Registered, without articles of association, by F. C. Moon, 1, King's Arms Yard, E.C.

William Houghton and Company, Limited (38,211).—company was registered on the 16th inst. with a capital of £10,000, in £10 shares. To purchase and take over as a going concern the undertaking and business carried on by Wm. Houghton & Co., as engineers and millwrights, at Great Grimsby, in Lincoln; together with the goodwill, patents, stock-in-trade, materials, goods, chattels, effects, machinery, plant, tools, fixtures, book debts, assets, trade debts, and liabilities; to continue to work and otherwise deal with the properties so acquired, and to carry on the business of agricultural and general engineers, machine and implement makers, mechanical engineers, ironmongers, colliery proprietors, and other similar undertakings. The subscribers (with one share each) are: Wm. Houghton, 20, Hainton Street, Great Grimsby, Lincolnshire, engineer; A. J. Houghton, 32, Eleanor Street, Great Grimsby, engineer; J. W. Houghton, Great Grimsby, engineer; C. A. Marshall, Great Grimsby, merchant; G. Marshall, Great Grimsby, merchant; J. K. Marshall, Great Grimsby, merchant; R. C. Walker, Great Grimsby, millwright. With very few alterations the regulations of Table A apply. Registered by Williamson, Hill and Co., 13, Sherborne Lane, E.C.

Lilly and Lilly, Limited (38,222).—This company was registered on the 17th inst., with a capital of £10,000, in £20 shares, to acquire the goodwill of a business carried on at 5, Whitcomb Street, Pall Mall East, and King William Street, Wandsworth Road, Surrey, under the style of "Lilly and Lilly;" to enter into an agreement made on the 16th inst. between Wm. G. Lilly and E. W. Winter, and to carry on the business of builders, painters, decorators, plumbers, upholsterers, ironmongers, gas, sanitary and electrical engineers, and any other business of a similar nature. The subscribers (with one share each) are:—E. M. Slater, Barnes, commission agent; J. Richards, Buckingham Gate; W. J. Akhurst, Wandsworth Common, accountant; W. F. Akhurst, Wandsworth Common, gentleman; T. E. B. Barker, Ealing, confectioner; A. Bennetts, Peckham, foreman builder; C. Richards, Buckingham Gate, W., gentleman. The rules of Table A are generally applicable. Registered by A. Alex. Nowell, 27, Chancery Lane, W.C.

James Macintyre and Company, Limited (38,217).—This company was registered on the 16th inst., with a capital of £50,000 in £10 shares, to acquire and take over, as a going concern, the business of earthenware and china manufacturers, stone and flint grinders, and manufacturers of apparatus and appliances for electric work, and otherwise heretofore carried on at the Washington Works and Victoria Mill, near Waterloo Road, Burslem, Staffs., under the style of "James Macintyre & Co.," and all or any of the liabilities of the proprietor; and to carry on the business of earthenware and china manufacturers, stone and flint grinders, and manufacturers of apparatus and appliances for electrical work in all their respective branches; and also to follow the businesses of quarry owners, mine owners, smelters, oil and colour men, paviors, wharfingers, and carriers by sea and land. The subscribers (with one share each) are:—Wm. Woodall, Burslem, earthenware manufacturer; C. W. Woodall, Burslem, potter's manager; H. Watkin, Burslem, potter's manager; C. Woodall, 50, Fitzjohn's Avenue, C.E., H. Woodall, Llandudno, gentleman; G. R. Redgrave, Muswell Hill, E.C., inspector of schools; C. E. Bullock, Hanley, chartered accountant. Until otherwise determined by a general meeting, the number of directors is not to be less than three nor more than five, the first being Wm. Woodall, C. W. Woodall, and H. Watkin. Qualification £1,000; remuneration to be yet fixed by the company. Registered office, Waterloo Road, Burslem, Staffs.

Swinburne and Company, Limited (38,214).—This company was registered on the 16th inst. with a capital of £25,000, in £5 shares, to carry on the business of electrical engineers, electricians, engineers and contractors, suppliers of electricity, manufacturers of electrical apparatus, mechanical and chemical engineers; to produce light, heat, sound, and power by electricity, galvanism, magnetism, or otherwise, and to carry on other convenient businesses. The subscribers (with 1 share each) are: James Swinburne, 49, Queen's Road, Wimbledon, electrical engineer; B. R. Beale, Angel Lane, Northampton, electrical engineer; H. S. Sherwin Holt, Oaklands, Teddington, electrical engineer; J. Holt, Farnbrook, Hants, Esq.; F. G. Kenyon-Slaney, Bassett, Southampton, Capt. 1st Durham Light Infantry; E. M. S. Kenyon-Slaney, Bassett, Southampton, Capt. 1st Durham Light Infantry; H. Bostock, Walton Heath, Epsom, gentleman. The rules of Table A usually apply. The first directors are to be J. Swinburne, H. E. Sherwin Holt, B. R. Beale, W. Lethbridge, and Hewitt Bostock;

qualification, £25; remuneration to be determined by the company in general meeting. Registered office, Broom Hall Works, Teddington.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Woodhouse & Rawson United, Limited.—The annual return of this company, made up to the 5th ult., shows that out of a nominal capital of £550,000 in 60,000 ordinary shares of £5 each, and 50,000 preference shares of £5 each, 55,197 ordinary and 41,008 preference shares have been taken up. There have been 8,564 ordinary and 9,936 preference shares, representing the value of £92,500, agreed to be considered as paid. The full amount has been called upon 31,072 preference and 9,119 ordinary, and upon the remaining ordinary shares calls realising £3 15s. per share have been made, resulting in the payment of £334,351 12s. 6d., including 60 forfeited shares. There is still £7,280 17s. 6d. in arrear, and £180 due on the shares forfeited.

S. Z. De Ferranti, Limited.—The annual return of this company has been filed at Somerset House, and shows a nominal capital of £100,000, in 2,000 £7 per cent. preference, and 8,000 ordinary shares of £10 each. At the time of making up all the shares had been taken, of which seven preference shares have had the full amount called and paid, the remainder having been issued as fully paid, according to an agreement made when the company was incorporated.

Richmond (Surrey) Electric Light and Power Company, Limited.—The statutory return of this company has been made up to January 19th last, and shows that only seven shares, out of a capital of £50,000 in £5 shares, have been taken up. The full amounts have been called and all calls duly paid.

Ogmore Valley Electric Light and Power Supply Company, Limited.—The annual return of this company, was registered on December 9th last, and shows that out of a nominal capital of £10,000 in £5 shares, 619 shares have been taken up. There has been £4 called on 599 shares and £1 on the remaining 20. The total amount of calls received was £2,161. The sum still unpaid reaches £255.

Queen Anne's Mansions Lighting and Heating Company, Limited.—The annual return of this company, made up to the 9th ult., shows that out of a nominal capital of £60,000 in 3.000 preference and 3,000 ordinary shares of £10 each, the whole have been taken up. The full amount has been paid.

Laurence Scott and Company, Limited.—The annual return of this company was filed on January 12th, 1893, and shows that out of a nominal capital of £30,000 in £10 shares, 1,406 shares have been taken up, of which 500 have been considered as paid. The full amounts have been called upon the remaining 906 shares, the full amount on which has been paid. The total amount of this call is £9,060.

Mulholland, Maughan and Company, Limited.—The annual return of this company has lately been filed, and shows that out of a nominal capital of £5,000 in 120 founders' and 380 ordinary shares of £10 each, the whole of the founders' and 167 ordinary shares have been taken up. The full amounts have been called upon the former class of shares, but only £5 per share has been called on the latter. The total result is £2,035.

Poole and White, Limited.—This company is in course of liquidation. Mr. E. Wilding, of Bloomsbury Mansions, Hart Street, W.C., being appointed liquidator.

Maquay Syndicate, Limited.—A resolution has been passed and confirmed to the effect that this syndicate should be wound up voluntarily under the provisions of the Companies' Acts, 1862 and 1867, and that Mr. T. Rawlins, of 45, King William Street, E.C., accountant, be appointed liquidator for that purpose.

Morecambe Electric Light and Power Company, Limited.—The annual return of this company, made up to December 27th last, shows that out of a nominal capital of £15,000 in 14,950 ordinary and 50 founder's shares of £1 each, 50 founder's and 3,836 ordinary shares have been taken up. There has been £1 per share called on the founder's, 16s. per share on 2,985 ordinary, and £1 per share considered as called on each of 851 ordinary shares. The total amount of calls received, including £262 paid in advance of calls, and £11 15s. on forfeited shares, is £2,350 10s. The sum unpaid is £361 5s.

British Electrical Installation Contractors, Limited.—It has been decided to wind up this company voluntarily, and Mr. W. J. Hill, of 50, Flosgate, Worcester, has been appointed liquidator.

Lancashire and Yorkshire Electric Lighting Company, Limited.—The annual return of this company, made up to July 12th last, was filed on the 30th ult., and shows that out of a capital of £100,000, in 20,000 £5 shares, 127 shares have been taken up. There has been a call of £2 10s. per share, which has resulted in the payment of £315. A sum of £2 10s. remains in arrear.

Peru Telephone Company, Limited.—The annual return of this company, made up to January 4th last, shows that out of a total capital of £100,000, in 20,000 £5 shares, only seven shares have been taken up. No calls have been made, nothing has been paid, and the only shareholders are the subscribers to the memorandum of association.

Varley's Electric Patents Proprietary, Limited.—It has been decided to hold a meeting at 527, Mansion House Chambers, E.C., on the 14th prox., at noon, for the purpose of receiving an account of the winding-up.

Newcastle-upon-Tyne Electric Supply Company, Limited.—The annual return of this company, made up to February 2nd, was filed on the 7th inst., and shows that out of a nominal capital of £50,000 in £5 shares, 6,104 shares have been taken up, of which 43 shares have been considered as paid. A call of £4 per share has been made on the remaining 6,061 shares, and the payment resulting from this is £25,984, which includes £1,740 paid in advance of calls.

Loughborough Electricity Supply Company, Limited.—The registered office of this company according to the file at Somerset House, is situated at 112, Belvedere Road, S.E.

House Telephone Company, Limited.—This company has its registered office at 85, Queen Victoria Street, E.C.

CONTRACTS OPEN AND CLOSED.

OPEN.

Dublin.—March 2nd. For additional dynamos, engines, &c., for the Corporation. Further particulars from Mr. Spencer Harty, City Hall, Dublin.

Gateshead.—No date stated. The Gateshead Industrial Co-operative Society, Limited, invite specifications and tenders for the supply and fixing of all plant, &c., necessary for a complete installation of the electric light in their Jackson Street premises, Gateshead.

Mons (Belgium).—March 15th. For the supply and complete installation of all apparatus and accessories for the electric lighting of the tracks, covered station and two locomotive shops for the Belgian State Railways (Spec. No. 27). Further particulars from the Brussels Bourse.

Old Swindon.—No date stated. It has been resolved by the Local Board to advertise for tenders for lighting the district by electricity.

Portrush.—March 1st. For the electric lighting of the town for the Commissioners. Further particulars from Mr. M. A. Fleming, town clerk, Portrush, Ireland.

Teruel (Spain).—February 28th. For the letting of the electric lighting of the Alcaniz Municipality for 10 years. Further particulars from the Alcaniz town authorities, Teruel, Spain.

CLOSED.

Bristol.—The tender of Messrs. Siemens Brothers & Co., for the supply, delivery, and erection, of various electric lighting appliances, has been accepted at £16,658 10s.

BUSINESS NOTICES, &c.

Action *re* Guides to Chicago.—In the High Court of Justice, Chancery Division, before Mr. Justice North, last Friday, the case of Reuter's Telegram Company, Limited *v.* International Guide Syndicate and Express, Limited, came on for hearing. Mr. Hardy, Q.C., moved, on behalf of the plaintiffs in this action, for an interim injunction to restrain the defendants from printing, publishing, selling, or offering for sale, a directory and guide to the "World's Columbian Exposition," or disposing of any copy under the title of "The Official Guide." Mr. Ford, for the defendants, objected to the motion being heard on the ground that he had not received the plaintiff's affidavits in time to answer them. Mr. Hardy reminded his Lordship that he had obtained leave to serve short notice of motion, and unless the defendants would give an undertaking, he must press for an injunction. He stated that the plaintiffs had obtained the sole right of publishing in Europe the official guide and directory to the Exhibition, and they alleged that the defendants had announced their intention of publishing an official guide. What was principally complained of was the defendants calling their guide official. His Lordship did not see the necessity of interfering at the present time, and directed the motion to stand over until this week, such arrangements being come to between the parties as to the filing of affidavits as would enable the motion to be effectively brought on immediately.

Cooking, &c., by Electricity.—Messrs. Crompton and Company showed an assortment of their new electrical heating apparatus at the president's reception at the Institution of Civil Engineers on Tuesday, February 21st. The room in which this apparatus was working was crowded, and the large electric oven shown in full operation created a considerable amount of interest. Boiling, frying, baking, coffee grinding, &c., were shown, and many members of the Institution present were surprised to see that Messrs. Crompton & Co. have brought the application of electric heating to the present stage, as they were under the impression that the apparatus talked of was merely a toy. Messrs. Crompton state that they have received a number of orders for electric ovens, and they have difficulty in meeting the orders for other apparatus which is being used in many parts of the country, and abroad.

A New Switchboard.—A new switchboard came into operation the other day at the Sheffield offices of the National Telephone Company, by means of which, and the concentration of the various exchanges into one, it is hoped there will soon be no ground for complaints of delay. The whole of the four Sheffield exchanges have now been concentrated into a central exchange.

The Helios Company.—The International Electric Company, of 34, Aldermanbury, E.C., have just been appointed sole agents for the United Kingdom, by the Helios Company, Limited, Koln-Ehrenfeld, for the sale of their well known arc lamps for direct and alternating current. These lamps, it will be remembered, were pronounced by experts at the Frankfort Exhibition to be the best shown there. All inquiries respecting the lamps should be addressed to 34, Aldermanbury, E.C.

Laxton's Builders' Price Book.—The growing importance of electric lighting is illustrated by the fact that in the new edition of Laxton's Price Book, nineteen pages are devoted to this subject as compared with five pages in the edition of six years ago. The matter is very carefully put together and includes a copy of the "Sun" Fire Office rules, and valuable information as to various systems of lighting in a condensed and practical form.

Lists, &c.—We have received from the Britannia Company, of Colchester, copies of their latest lists of drilling machines.

Messrs. G. E. Belliss & Co., Ledsam Street Works, Birmingham, have sent us their latest list, January 1893, of patent double-acting high speed noiseless engines, for driving dynamos direct.

Malton Electric Lighting.—The first installation of the electric light at Malton has just taken place, at the works of the Malton Farmers' Manure and Trading Company, Limited. The electric plant has been put in by Messrs. Parr & Gillies, of Haggerston and Buckingham.

Morecambe Electric Lighting.—In regard to the proposed lighting on the front it has been resolved unanimously that the plan submitted by the Morecambe Electric Light and Power Company, Limited, for laying a cable across Marine Road, opposite Clarence Street, be approved so far as regards compliance with the bye-laws.

Richmond Electric Lighting.—The Town Council have resolved to enter into an agreement with Messrs. Latimer Clarke, Muirhead & Co., for the supply of electric light to the new municipal buildings at the rate of 6½d. nett. per unit.

Standard Machine Screws.—We have received samples of the work turned out by the Automatic Standard Screw Company, of Halifax, and have pleasure in calling the attention of the trade to the excellence of their threads.

New Telephone Company.—This company have sent us a copy of their latest issue of subscribers to their Manchester system. There appears to be a large addition of names since the last book was published.

Personal.—Mr. Murray Walker, A.M.I.C.E., has lately resigned the post of works manager to the Elmore's Patent Copper Depositing Company. Mr. Walker is now proceeding to South Africa on engineering business.

The Military Search Light.—Captain Ronald Scott occupied the chair on Saturday evening at the annual dinner of the F Company of the West London Rifles (4th Middlesex), held at the "Horse Shoe" Hotel, Tottenham Court Road. In responding to the toast of his health, he referred to the improvements he had been able to make in his light since it was first used at Elstree, when they had to transport a dynamo to the field of operations and pin it to the ground with stakes. He had, he said, now designed a waggon, which he expected to have completed in a few days, in which the whole of the apparatus could be easily and quickly transported from point to point, and this he would be able to use at Huddersfield on March 18th, when some extensive night operations would, with its assistance, be carried out by the Yorkshire volunteers. He had recently been asked to attend at the Horse Guards to consult with the authorities there as to the use of his light, and he thought it probable that within a short period they would test its capabilities at a big night attack not very far from London.

"The Training of Electrical Engineers."—This is the title of a pamphlet just published by the Electrical Standardising, Testing and Training Institution.

CITY NOTES.

The Westminster Electric Supply Corporation, Limited.

THE ordinary general meeting of the above was held on Wednesday last at the Corporation's offices, Eccleston Place, Eccleston Street, Belgravia, S.W., Lord Suffield, K.C.B., presiding.

The SECRETARY (Mr. Frank Iago) having read the notice convening the meeting, the report and accounts were taken as read.

The CHAIRMAN, in moving the adoption of the report, said he would take the opportunity of congratulating the shareholders on the fact that the Corporation had now reached the position of a dividend paying concern. They would see from the accounts that the net earnings of the past year had been £8,656 8s. 1d., to which must be added £3,159 14s. 3d. brought forward from 1891, making £11,816 2s. 4d. at credit of net revenue. Out of that the directors had paid an interim dividend at the rate of 3 per cent. per annum for the half-year ended June 30th, 1892, and they now recommended the payment of a dividend at the rate of 4 per cent. for the past half-year, carrying forward a substantial sum. The directors felt, and he was sure the shareholders would agree with them, that the aim of the Corporation should not be to pay large dividends at first, but rather to build up the business on a sound basis, and, at the same time, pay to the shareholders fair dividends out of the profits of the undertaking. They had written off all bad debts, which were a very small proportional part of the preliminary expenses and suspense account; depreciation of plant, buildings and furniture, and no sum fairly chargeable to the revenue of the year had been carried to capital account or suspense account. They would observe that the depreciation of plant had been fixed at £2,500 for 1892, and that the directors considered to be a fair amount, looking at the fact that some of the plant was not ready for use at the beginning of 1892, to the efficient state in which the plant had been maintained, and the expenditure for repairs and maintenance, which had been charged to revenue exclusively. The whole of the plant had worked thoroughly well during the past year, and the stations for generating the supply were well equipped and working most satisfactorily. When he had the pleasure of meeting them last year, attention was drawn to the fact that for the two last quarters of the year 1891 the cost per unit had shown a great decrease in comparison with the preceding periods, and they would be glad to learn that in the year ending December 31st last, the expenditure under that head had shown a still greater economy. They would notice that they now had mains laid in 33 miles of roadway, equal to about 130 miles of ways, and practically the whole of the principal streets in their area had been laid, with the exception of the streets now being rebuilt on the Duke of Westminster's estate of Mayfair. It had been, and still was the principle of the directors not to lay a main in any street unless it gave a good prospect of profit on the expenditure. This policy had resulted in the capital expended in the streets, earning on the whole a fair profit. Owing to the number of lights supplied, it had become necessary to raise more capital, and the directors therefore carried out the promise made at the last general meeting, and offered an additional amount of £40,600 in £100 debentures to the then existing shareholders. Owing to the progress made by the Corporation they were enabled to do this at a reduced interest of 4½ per cent. per annum; the original rate was 5 per cent. The whole of this issue was at once taken up by the shareholders. Some idea of the advance of the business might be gathered from the fact that whereas on December 31st, 1891, the electrical energy supplied was equivalent to 62,820 lamps of 8-C.P., on December 31st, 1892, the number had increased to 98,686, while at the time the report was printed the equivalent of 102,743 lamps of 8-C.P. were on circuit. Applications were in hand for a further 8,229, showing that applications were still continuing at a considerable rate. They would be gratified to learn that in addition to the numbers already given, the Corporation had been ordered to supply the light to Her Majesty's Foreign Office, which they hoped would be followed by other large Government offices in Whitehall. He was not aware of the exact number of lights likely to be installed, but he knew that eventually it would be considerable, which they were now prepared to take. The installation at the Houses of Parliament had also been largely increased by the connection of the current to the House of Lords. He must next refer to the reduction

already made, and about to be made, in the charge per unit. In June last, they came to the conclusion it was advisable to reduce the price from 8d. per unit, as allowed by the provisional order, to 7d. He thought he was right in saying that the Westminster was the first supply company in London to voluntarily reduce the price, and experience had shown them it was a wise step to adopt, as not only had it created a good feeling among those on circuit at the time, but had greatly increased the number of applications. There was no doubt many existing consumers added to their extensive installations because of that reduction. The directors had again had that matter under consideration, and felt that the time had now come when they, in justice to the consumers, were well able to further reduce the charge. They had therefore issued their intention to still further reduce the standard charge to 6d. per unit from March 31st, with a sliding scale of rebates to very large customers. They felt confident that by dealing thus liberally with their consumers they would not only retain their present customers, but so largely increase the number of applications as to be able to earn a larger net revenue than if they held to the present charge of supplying. He would not further detain them excepting to say that while their directors had given their best attention to the concerns of the corporation—which went, he hoped, without saying—they were greatly indebted to an excellent staff for the success of the undertaking, the untiring zeal and large experience of their engineer-in-chief (Prof. Kennedy) had proved invaluable, and he had by his forethought and great care succeeded in supplying continuous current with the utmost regularity, and as to which no cause of complaint had arisen. Their manager, Captain Bax, had given them in all respects complete satisfaction, as had also their secretary, Mr. Iago. He must congratulate them as shareholders upon having sailed out of troubled waters into a secure position. After a few remarks regarding competition with which they had had to contend, he formally moved the adoption of the report and accounts.

Mr. J. H. POWELL seconded the motion, and, in doing so, drew attention to some diagrams on the wall, which showed the increase in number of lamps, &c., during the year, and also the remarkable augmentation in consumption effected by fogs.

In reply to Mr. FITCH (shareholder),

Prof. A. R. W. KENNEDY said, in regard to Mr. Fitch's remarks, the St. James's Company generated practically the same number of units with just half the number of lamps, that was, every lamp took just double the current per annum. Of course, it was enormously more economical to furnish the light in that way; besides, the company to which he had referred, had only one station instead of three. In spite of that fact, the Westminster Company, he thought, were really doing the better, because their district was five times as large, with, at the present, the same output; but he was sure, from that point of view, it would interest the shareholders, in face of what Lord Suffield had said, if he just mentioned the comparison between their first six months and the second six months. In the first six months of the year the company sold, in round numbers, 560,000 units, and the total expenses in the balance-sheet were £6,890, whereas, in the second six months, they sold 660,000 units, and their total expenses were £6,730, that was £160 less, so they had generated 100,000 units extra at £160 less expenditure.

The CHAIRMAN then put the motion to the meeting, and it was carried unanimously.

It was next proposed by the CHAIRMAN to declare a dividend for the last half-year, ending December 31st, 1892, at the rate of 4 per cent. per annum, payable on March 1st.

Mr. R. W. WALLACE seconded the resolution, which was carried.

The retiring directors, Mr. J. Browne Martin and Mr. R. W. Wallace, having been re-elected, Messrs. Cooper Bros. & Co. were re-elected auditors at a fee of 50 guineas.

A vote of thanks to the chairman and directors was proposed by Sir H. MARK STUART and carried.

The Chairman having replied thereto the proceedings terminated.

The Cuba Submarine Telegraph Company, Limited.

THE directors' report for the half-year, ending December 31st, 1892, presented at the forty-third ordinary general meeting of shareholders, held on Wednesday last, February 22nd, at the offices of the company, reads as follows:—"The directors beg to submit, duly audited, the balance-sheet and accounts for the half-year ended December 31st last. From these it will be seen that the gross receipts (including the balance brought from last account) amount to £22,850 15s., and the gross expenditure (including the balance of the contract price of the 1881 cable) to £6,972 16s. 4d., leaving a sum of £15,877 18s. 8d. to the credit of revenue account. Of this the sum of £1,500 has been set aside as a reserve against any loss from the deposit with the New Oriental Bank Corporation, which is now in liquidation, and £4,500 added to the reserve fund, making that fund £94,500. The dividend on the preference shares will absorb £3,000, and leave £6,877 18s. 8d., out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 8 per cent. per annum, free of income tax, the balance, £477 18s. 8d., being carried forward to the current half-year's account. The main cables have continued in good order throughout the half-year, but the harbour lengths at Cienfuegos and Santiago have been interrupted. Three new lengths, one at Cienfuegos and two at Santiago, have been laid by Mr. Keith since the end of the year. The cost of this work and of the repairs to the old lengths will appear in the accounts for the half-year to June 30th next. A little progress has been made in the company's suit against the Spanish Government at Madrid. The Government has issued a Royal order for the verification by the Cuban authorities of certain points raised in the case."

At the meeting on Wednesday Mr. Charles W. Parrish presided.

In moving the adoption of the report and accounts for the half-year ended December 31st last, the Chairman stated that they had had no interruptions in their traffic. Comparing the past half-year with the corresponding period of 1891, there had been an increase of over £700 in their receipts this time, and this was an especially favourable result when they noticed that there had been an actual reduction in their working charges of £235. They were all aware of the failure of the New Oriental Bank, with which their company had a deposit of £3,000. As there were grounds for fearing that the liquidation of this unfortunate bank might not be satisfactory, the directors had charged the half-year's profits with £1,500 as a reserve against any loss they might sustain. They had been able to carry £4,500 to the reserve fund, which now amounted to £94,500.

Mr. A. F. Low seconded the motion, which was unanimously adopted; and dividends were then declared on the preference shares at the rate of 10 per cent. per annum, and at the rate of 8 per cent. per annum, free of income tax, on the ordinary shares.

A vote of thanks to the chairman and directors closed the meeting.

Kensington and Knightsbridge Electric Lighting Company.

THE sixth ordinary general meeting of the shareholders of the above company was held on February 16th, at 1, Great George Street, Westminster, Mr. Granville R. Ryder (the chairman) presiding.

Mr. R. S. ERSKINE (the secretary) having read the notice convening the meeting, the report and accounts were taken as read.

The CHAIRMAN, in proposing the adoption of the report, said the shareholders would agree with the directors in the satisfaction they felt that the past year's working showed steady and substantial progress, though, perhaps, not quite so rapid as they could have wished. At the same time there were several features of an encouraging and satisfactory character about the past year to which he would like to draw their attention. In the first place with regard to the buildings and shops taking the light, the number on December 31st, 1891, was 436, and on December, 31st, 1892, it had risen by 550, showing an increase of 114. The number of 8 candle-power lamps in use had sprung from 38,408 on December 31st, 1891, to 47,441 at the end of last year, that being an increase of 9,033. There was a very satisfactory increase in the output of units, which had risen from 385,051 at the end of 1891, to 535,343 in 1892, being an increase of 150,272. The earnings per 8 candle-power lamp had practically remained stationary; in fact, if anything, they were rather less, the figures being 7s. 7d. per lamp in 1892, against 7s. 8d. per lamp in 1891. With regard to the gross earnings in 1891, they were £12,266, while last year they had increased to £16,628, an increase of £4,361. The net profits had increased by some £2,446; that was to say, from £4,351 in 1891, to £6,828 in 1892. There was a very satisfactory point he wished to call their attention to in these figures, and that was that the ratio of profit to gross receipts had been considerably increased. It had increased from 36 per cent. in 1891 to 42 per cent. in 1892. That point might be further elaborated by putting the increase of profit of £2,446 against the increase of gross earnings of £4,361, when the increase would stand at something over 56 per cent. of profits as against gross earnings. That he thought was an extremely satisfactory item, because it showed that the ratio of profit increased with the increase of the business. The next point was with regard to the capital expenditure during the past year. The total amount spent was £12,800 in round figures, and the main items in the expenditure were as follows: Buildings, £868 (that really had been spent on coal bunkers at their Knightsbridge station, which would be a great help to them in their business); £1,778 had been spent on batteries, £733 on connecting new mains, £1,013 on meters, £3,764 on plant, and £4,441 on mains, which was the largest item. No doubt the shareholders would observe that there was a very considerable increase in the capital account. The mortgage debentures issued last year, came to £29,400, whereas in the former account—that was down to December 31st, 1891—the amount was £7,930. There would, therefore, naturally appear to be a discrepancy, because £12,800 only had been spent on capital account, and the increase on mortgaged debentures had amounted to over £8,000. By looking at the figures, however, and comparing them with those of last year, they would see that in the item following that of the mortgage debentures, there was an item of sundry creditors and general accounts which stood in 1891 at £11,347, whereas in the present account it stood only at £3,011. At the end of 1891, as a matter of fact, they had drawn a good deal on the debentures, which were practically issued and taken up in January, 1892, and that really accounted for the difference of £8,000. Another item which required explanation was the suspense account (law) £1,800. That came from the action which was brought against them by Mr. Lane-Fox. They did not stand to lose the whole expenses of the contest themselves, for some of the other electrical lighting companies joined with them, and some private firms as well. The total cost of the action was over £6,000, and the amount which fell upon them was about £2,000. As the shareholders probably knew, they gained a victory over Mr. Lane-Fox, but it was perhaps true in law, as in many other things, that the next worse thing to a reverse was a victory. Mr. Lane-Fox was condemned in the costs, but up to the present moment those costs had not been paid. Whether they would be paid or not, he could not say, but negotiations were going on which they hoped would result in their obtaining their costs. The actual amount which they had had to pay was about £1,300, which would reduce that item of expense to £300, which was a very small amount. As he had said, at the present moment it was utterly impossible for him to say whether they would ever get the money from Mr. Lane-Fox; but the shareholders might rest assured that the directors would do all in their power to do so. The next item in the accounts

was the first one in the revenue account, that of manufacturing electricity, which was highly satisfactory, as it stood at £3,746, against £4,067 last year. Thus, though there was an increase of output of very nearly one-third, the expense of production had been something like £300 less. That, he thought, was very satisfactory, and reflected the greatest credit upon the staff. The principal item of diminution was in wages, which showed that the directors had given attention to the economical working of the business; and it was very satisfactory to find that they had proved so successful. With respect to the item of bad debts, £393 6s. 9d. that was rather an exceptional amount, and he hoped it would not be so high again. It arose in the present instance, however, mainly from Hyde Park Court, which was one of Hobbs & Co.'s properties, and he was therefore afraid there was no likelihood of their ever getting their money. The renewal account included £2,124 for the actual maintenance of buildings, mains, plant, &c., and added to that was £921 which had been written off what they might call antiquated plant. With respect to the area which they had purchased from the Chelsea Electricity Supply Company, he believed it would be a very profitable investment for the company, and although the present earnings were only £1,700 a year, without any increase he thought they would get a good 10 per cent. on their purchase money. In conclusion the chairman said he would like to remind the shareholders that no provision had been made in the accounts for director's remuneration. Up to the end of 1891 the directors were paid by certain shares which were handed over to them by the old Kensington Court Company; but the directors desired the shareholders to know that their remuneration from that source ceased at the end of 1891.

Mr. G. H. HOPKINSON seconded the motion which, after some discussion, was agreed to.

Mr. WYLLIE then proposed, and Mr. SAUNDERS, Q.C., seconded a resolution voting £350 to the directors for their past years' services.

The motion was agreed to, as was a resolution declaring a dividend at the rate of 4 per cent. per annum on the ordinary capital of the company for the year ended December 31st last.

The two retiring directors, Messrs. G. H. Hopkinson and Mr. Granville R. Ryder, having been re-elected, the proceedings closed with a vote of thanks to the chairman for presiding.

The Electricity Supply Corporation Limited.

THE directors' report reads as follows:—"The directors beg to submit their annual report for 1892, with the accounts for the same period duly certified by the company's auditors. The corporation are now supplying energy to 29,000 8-C.P. lamps, an addition of 7,000 since May last, or an increase at the rate of, or about, 32 per cent. on the number then supplied. Applications have been received and negotiations are pending for a substantial addition to this number. Additional mains to the extent of about two miles have been laid, making a total of upwards of 18 miles of mains now laid. Out of the available profits the directors, after providing for the interim dividend up to June 30th, 1892, and writing off the debit balance brought forward for 1891, propose to declare a dividend for the year up to December 31st, 1892, at the rate of 5 per cent. on the capital from time to time paid up, and to carry forward the balance. The directors have every reason to be satisfied with the progress and future prospects of the company. The directors retiring by rotation are Mr. George Henry Brougham Glasier and Mr. Isaac Percy Mendoza, who, being eligible, offer themselves for re-election. The auditors, Messrs. O. R. Johnson and Son, also retire and offer themselves for re-election."

ABSTRACT OF ACCOUNTS to December 31st, 1892.

CAPITAL ACCOUNT.

Dr.	£	s.	d.
To Expenditure per last account	120,288	9	9
„ Further expenditure to December 31st, 1892 ...	78,259	14	7
„ Law costs	225	0	0
„ Balance of capital account	2,126	15	8
	£200,900	0	0

Cr.	£	s.	d.
By Ordinary shares	150,000	0	0
„ Debentures	130,900	0	0
	280,900	0	0
Less debentures satisfied during 1892...	80,000	0	0
	£200,900	0	0

REVENUE ACCOUNT.

Dr.	£	s.	d.
To Generation of electricity	7,639	1	7
„ Distribution of electricity	551	17	1
„ Proportion of rents, rates, and taxes	696	6	9
„ „ „ management expenses	1,429	5	0
„ „ „ law and parliamentary charges ...	52	10	0
„ Other items	292	0	0
„ Balance	9,997	13	3
	£20,658	13	8

Cr.	£	s.	d.
By Sale of current per meter }	19,717	1	4
„ „ „ under contract }			
„ Rental of meters, converters, &c.	199	19	9
„ Transfer fees	2	3	0
„ Rents receivable	589	14	5
„ Other items	149	15	2
	£20,658	13	8

NET REVENUE ACCOUNT.

Dr.	£	s.	d.
To Balance from last account	919	14	2
„ Transfer from suspense account	557	18	8
„ Interest on debentures and temporary loans ...	4,271	0	6
„ Balance	4,248	19	11
	£9,997	13	3

Cr.	£	s.	d.
By Balance from account	9,997	13	3
	£9,997	13	3

RESERVE FUND.

Dr.	£	s.	d.
To Balance carried forward	250	0	0
	£250	0	0

Cr.	£	s.	d.
By Amount brought from net revenue account	250	0	0
	£250	0	0

GENERAL BALANCE SHEET.

Dr.	£	s.	d.
To Capital account	200,900	0	0
„ Sundry tradesmen and others, on construction of plant, machinery, fuel, &c.	7,666	14	8
„ Sundry creditors on open accounts	1,940	4	9
„ Reserve fund account	250	0	0
„ Net revenue account, balance at credit thereof, less £86 10s. 7d. paid for interim dividend ...	4,162	9	4
	£214,919	8	9

Cr.	£	s.	d.
By Capital account	198,773	4	4
„ Cash at bankers	2,322	15	7
„ Cash in hand	5	19	3
„ Sundry debtors for current	8,364	7	1
„ Stores on hand	313	12	3
„ Purchase of premises not in the occupation of the company	5,139	10	3
	£214,919	8	9

The annual ordinary general meeting of the shareholders of this company was held on Friday last at the Town Hall, St. Martin's-in-the-Fields, Charing Cross, W.C., Mr. Spencer Chadwick occupying the chair.

The notice convening the meeting was read by Mr. E. WILMOT SEALE (secretary and general manager).

The CHAIRMAN said he presumed they would take the report and accounts as read. There were one or two observations which he wished to make. As regarded the reserve fund of £250 provided for bad and doubtful debts, that was believed to be more than sufficient for the purpose. Then the amount available for dividend, as they would find on referring to the revenue account, amounted to £4,248; but that sum would have been £5,726 but for the facts that they had had to put out of profits, in accordance with the directions of the Board of Trade, the debit balance brought forward from the last account, and for the transfer from suspense account. Had it not been for that debit balance, the dividend for the past year would have been 2½ per cent. more. The profit for the past half-year showed a large increase of business, and if anything like the same amount of progress was maintained, the progress for the present year would be much in excess of that in 1892. Negotiations were now pending with probable customers, and which might result in their acquiring orders to supply current for some 4,000 or 5,000 8-C.P. lamps. Therefore the directors looked for the increase being maintained, and the number of lights now in touch with them could be supplied without increasing their plant. Indeed, the present plant was considerably more than sufficient to supply that number of lamps. With regard to the working capital, applications had been made for the remaining £19,100, but in the interests of the shareholders they had decided not to call up one shilling more than was absolutely required from time

to time. By adopting that course they would save a considerable amount of interest on dead capital, or by way of interest on debentures. The directors proposed to set aside a substantial sum for depreciation, which they had not felt themselves justified in doing in the past year, inasmuch as the machinery and plant were new, and had been maintained in the highest state of efficiency. The secretary would probably read the report of the engineers, and which would satisfy the shareholders on that point. The balance carried forward, after paying the dividend, would be £375, and that of course would be available for dividend next year. With those remarks he proposed that the report and accounts be adopted, and that the dividend of 5 per cent. be declared.

Mr. G. H. BROUGHAM GLASIER seconded the motion.

Colonel YOUNG observed that under the head of assets there appeared sundry debtors for current supplied to the extent of £7,302. The amount was large; there might probably be a reason for it, but it seemed that there should be some explanation given on the matter. Another question he would like to ask was about their shares. He did not know whether the shares were yet quoted on the Stock Exchange; he had not noticed that they were. He would be glad to learn, in pursuance of the paragraph in the prospectus stating that in due course application would be made to the Stock Exchange, whether such application had been made. If so, what was the result; and if not, why?

The CHAIRMAN, in reply, remarked that the item of assets of £7,302 could not be otherwise than a large sum, having regard to the current supplied. They would observe that on the other side there were sundry creditors, and, of course, one was set against the other. Naturally, at that early period, so soon after Christmas, it had been impossible to get in the amounts from the various consumers. The accounts were prepared to the end of December, and the payment for current was only due on December 25th, so that it was impossible to collect the accounts for some weeks afterwards.

Col. YOUNG asked what proportion the item bore to the total amount received.

The CHAIRMAN said that it was about one-third, and that it represented the increase of business done in the last quarter.

Col. YOUNG was glad to hear the explanation, because that implied that they had increased their sale of current during the last half-year. On the other hand, if it was that people were being supplied with current, and were not paying for it when it was due, it was not quite so satisfactory.

Mr. FLADGATE (the solicitor) said, with regard to getting a quotation on the Stock Exchange, application would be made in due course; but as the whole of the capital had not yet been taken up, it had been impossible to make an application. The matter would, however, be dealt with as soon as it could possibly be done with a fair hope of success.

Mr. MILLAR imagined that the greater portion of that amount (£7,302) had now been received.

The CHAIRMAN observed that most of it had been received. He then put to the meeting the motion, which was carried unanimously.

On the proposal of Mr. NING, seconded by Mr. PUTNEY, Mr. G. H. Brougham Glasier and Mr. I. Percy Mendoza, were re-elected directors.

Mr. CHAPPLE then moved, and Col. YOUNG seconded, that the auditors, Messrs. O. R. Johnson and Son, should be re-appointed at a remuneration of 50 guineas.

This was carried, and a vote of thanks to the directors, proposed by Mr. WYBROW ROBERTSON and seconded by Mr. CHAPPLE, terminated the proceedings.

Telegraph Construction and Maintenance Company, Limited.

THE directors' report to be submitted to the members at the twenty-ninth ordinary meeting to be held at the offices of the company, on Tuesday, February 29th, 1893, at 1 o'clock, reads as follows:—"The directors have the pleasure to submit their twenty-ninth annual report to the members. The accounts for the year show a net profit of £51,579 1s. 5d., after charging the interest on the debentures. To this sum must be added £57,084 0s. 4d. brought forward from last year, making a total of £108,663 1s. 9d. From this amount is deducted the interim dividend of 5 per cent., paid July 12th, 1892, amounting to £22,410, leaving £86,253 1s. 9d. to be dealt with. Of this sum the directors propose to distribute a dividend of £1 4s. per share, absorbing £44,820, being at the rate of 10 per cent., and making, with the amount already paid, a total dividend for the year of £1 16s. per share, or 15 per cent., free of income tax, leaving £41,433 1s. 9d. to be carried forward to the next account. During the past year the following works have been carried out, viz.:—A cable has been manufactured, and laid between Santos and Chuy, on the Coast of Brazil, for the Western and Brazilian Telegraph Company. A cable has been manufactured and laid on the Coast of Sumatra for the Eastern Extension Telegraph Company, on account of the Dutch Government. Repairs have been made for the German Government in their Valentia-Greetseil cable; for the Direct United States Telegraph Company in their cable off the Coast of Nova Scotia; for the Western and Brazilian Telegraph Company in their lines off the Coast of Uruguay; and in the Anglo-American Telegraph Company's Brest-St. Pierre Atlantic cable. A contract has also been made with the African Direct Telegraph Company for connecting Bonny, on the West Coast of Africa, with the Cameroons River, on account of the German Government; and an agreement has been entered into with the West Coast of America Telegraph Company for the supply of a cable to connect Valparaiso and Talcahuano, the greater portion of these two lengths having been manufactured in 1892. Various lengths of cable have been manufactured for different telegraph companies during the year, and a total length of 4,222 miles of wire insulated for submarine and land lines. The company's steamships, and their factories at East Greenwich and Wharf Road, are in efficient condition. The directors regret that their colleague, Admiral of the Fleet, Lord John Hay, has resigned his seat on the board owing to the impossibility of his giving adequate attention to the company's affairs through his being obliged to pass the winters abroad. In accordance with the articles of association the directors have appointed Sir Robert G. W. Herbert, G.C.B., to fill the vacancy thus occasioned. The retiring directors are Mr. James Pender and Sir Robert G. W. Herbert, who, being eligible, offer themselves for re-election. The meeting will have to appoint auditors for the ensuing year. Mr. John Gane (of the firm of Messrs. Gane, Jackson and Jefferys), and Mr. Patrick A. Gleag (of the firm of Messrs. Welton, Jones & Co.), who retire, offer themselves for re-election."

The Liverpool Electric Supply Company, Limited.

THE report of the directors to be submitted to the shareholders at the ordinary general meeting of the company, to be held to-day, states that:—"In presenting their tenth annual statement of accounts the directors are glad to be able to report a steady increase in the demand for electric light, the number of lamps connected with the company's mains on December 31st, 1892, being equivalent to 20,254 16-C.P. lamps, as against 14,966 on December 31st, 1891. The amount to the credit of profit and loss account is £11,421 19s. 11d., which includes the balance brought forward from last year, and £627 18s. 8d. received as interest on shares, paid up in advance of calls, to entitle them to rank for dividend as from January 1st, 1892. The directors recommend the payment of a dividend at the rate of 5 per cent. per annum, free of income tax, absorbing £8,621, the addition of £1,500 to reserve fund, and to carry the balance, £1,300, forward to next year's account. The directors propose in future, provided the results of the business continue to justify this course, to pay interim dividends about September 1st, each year. The expenditure on capital account during the year, including a proportionate charge for general expenses, has been £34,786 19s. 7d. To deal with the increase of the company's business, the directors ask the authority of the shareholders to increase the nominal capital of the company by the addition of £100,000, making the total nominal capital £300,000. It is only proposed at present to issue 5,000 shares, which will be offered to the shareholders for subscription shortly after the general meeting. During the year Parliament has confirmed the provisional order referred to in the last annual report, under which the date for compulsory purchase of the company's undertaking, authorised by the provisional order of 1889, is postponed from 21 to 42 years, the corporation having the option of taking over the company's supply business in the City of Liverpool, as a going concern, after December 31st, 1897, at a price to be fixed by arbitration. During the year a new supply station has been established in Lark Lane for the Sefton Park district. It was intended to open this station in December last, but unexpected difficulties have arisen which have delayed the laying of the mains; it is, however, anticipated that these difficulties will shortly be satisfactorily settled. Two directors, Mr. J. S. Harmood Banner and Sir David Radcliffe retire by rotation, and, being eligible, offer themselves for re-election.

The Edison and Swan United Electric Light Company, Limited.—The directors resolved on 21st inst.: "That a payment on account of the dividend of the current year be made at the rate of 3½ per cent. for the half-year on the "A" shares; with the addition of a payment at the rate of 4·68 per cent. for the half-year in respect of accumulative arrears. This will work out in the following manner: On the 89,261 shares, £3 paid, 3s. 7¾d. per share; on the 5,000 fully paid shares allotted to the Edison Company, 6s. and ⅞ths of a penny per share; on the 12,139 fully paid shares allotted to the Swan United Company, 4s. 7¾d. per share. The payment will be made up in the register as it stands this day, and the dividend warrants will be issued on March 14th next."

Chelsea Electricity Supply Company, Limited.—The directors' report which has just been issued, and which is to be presented to the shareholders' meeting on Thursday next, 2nd inst, at the company's central station, Draycott Place, Chelsea, S.W., states that the net profits for the year, after paying debenture interest, amount to £1,336 2s. 7d., out of which it is proposed to pay a dividend of 2½ per cent. per annum on the ordinary shares, carrying forward the sum of £176 10s. 1d. to next year. There has been during the year a large saving effected in the consumption of coal. We shall print the report and accounts in full next week.

Elmore's French Patent Copper Depositing Company.—At a meeting held last Monday at the offices of the company, 64, Cannon Street, E.C., the debenture holders in this company sanctioned a resolution allowing the directors to create a further £50,000 of debentures for the purposes of the company's business.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending February 19th, 1893, amounted to £938; week ending February 21st, 1892, £872; increase £66; total receipts for half-year, 1893, £6,960; corresponding period, 1892, £5,905; increase £995.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending February 17th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,233.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation February 16th.	Closing Quotation, February 23rd.	Business done during week ended February 23rd, 1893. Highest.	Lowest.
195,100*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100 —103	100 — 103	...	...
1,247,720*l*	Anglo-American Telegraph, Limited	Stock	53½ — 54¼xd	53½ — 54½	54⅜	53⅜
2,876,140*l*	Do. do. 6 p. c. Preferred	Stock	95 — 96 xd	94½ — 95½	95⅞	94⅞
2,876,140*l*	Do. do. Deferred	Stock	13½ — 13⅝	13½ — 14	13 1/16	13⅛
130,000	Brazilian Submarine Telegraph, Limited	10	11½ — 11⅝	11½ — 12	12	11½
34,600*l*	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	104 —108	105 —109	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3⅛ — 3⅜	3⅛ — 3½	3½	3 5/16
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2¼ — 2½	2¼ — 2½	2⅜	2 5/16
125,000*l*	Do. do. 4½ per cent. Debenture Stock	Stock	104 —106	105 —107	106	105½
40,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	...	...
600,000*l*	City and South London Railway	Stock	37 — 39xd	35 — 37	37⅛	36⅜
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	12½ — 13	12½ — 13	13	12 11/16
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	8 — 8½	8½ — 8⅝	8 9/16	8 7/16
$7,716,000	Commercial Cable, Capital Stock	$100	175 —180	175 — 180	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ...	14/-	3/16 — 5/16	3/16 — 5/16	¼	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5 — 5½	5 — 5½	5 7/16	5⅜
16,000	Cuba Telegraph, Limited	10	12 — 13	12 — 13	12⅜	12¼
6,000	Do. do. 10 p. c. Preference	10	18 — 19	18 — 19	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½ — 3½	2½ — 3½	2⅞	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅜ — 12	11⅜ — 12	12	11 13/16
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅞ — 15⅛	14⅞ — 15⅛	15⅛	14⅞
70,000	Do. 6 p. c. Preference	10	15½ — 16	15¾ — 16⅛	16⅛	15⅞
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	106 —109	107 —110	...	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	112 —115	112 —115	112⅜	112½
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅛ — 15⅜	15⅛ — 15¼	15⅜	15¼
70,600*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	103 —106	103 —106	...	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	103 —106	103 —106	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	109 —112	110 —113	111⅜	...
122,400*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	102 —105	102 —105	103	...
163,700*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	102 —105	...	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	101 —104	101 —104	...	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	3½ — 4	3⅞ — 4⅛	3⅞	3⅝
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	⅛ — ¼	⅛ — ¼	...	...
82,395	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	⅛ — ⅛	⅛ — ⅛	7/16	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	¼ — ½	¼ — ½	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅝ — 9⅞	9⅝ — 9⅞	9⅞	9⅝
180,042	Do. do. 6 p. c. Preference	10	15⅛ — 15⅜	15⅛ — 15⅜	15⅜	15⅛
150,000	Great Northern Tel. Company of Copenhagen	10	19 —19½	19 — 19½	19⅜	...
210,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	106 —109	107½	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½ — 5½	4½ — 5½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6½ — 7½	6½ — 7½	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	22½ — 23½	23 — 24	23⅜	22½
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	103 —105	103 —105	...	...
17,000	Indo-European Telegraph, Limited	25	43 — 45	43 — 45	...	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	2½ — 3½	2½ — 3½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	6 — 7	6 — 7	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4 — 4¼	4¼ — 4½	4¼	4 1/16
10,000	Do. do. fully paid	5	5⅜ — 6	5⅜ — 6	5⅜	...
38,348	London Platino-Brazilian Telegraph, Limited	10	4 — 6	4 — 6	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	108 —111	108 —111	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6½ — 6⅝	6 — 6½	...	...
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	102 —105	102 —105	...	...
454,747	National Telephone, Limited, Nos. 1. to 438,984	5	5½ — 5⅝	5½ — 5½	5 7/16	5¼
15,000	Do. 6 p. c. Cum., 1st Preference	10	14½ — 15½	14½ — 15½	15	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	13¾ — 14½	13¾ — 14½	14¼	14
90,950	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	4⅜ — 4⅝	4⅜ — 4⅝	4 9/16	4 7/16
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	112 —115	113 —116	115	114
48,800*l*	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,318	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5½ — 6½	5½ — 6½	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	⅛ — ¼	⅛ — ¼	...	...
11,802	Reuter's Limited	8	7½ — 8½	7½ — 8½	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8 — 8½	8 — 8½	8½	8
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	8 — 8½	8¼	8
3,381	Submarine Cables Trust	Cert.	119 —124	118 —123	...	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	3 — 3½	3 — 3½	3⅜	3 1/16
37,350	Telegraph Construction and Maintenance, Limited	12	38 — 42	37 — 40	39	37½
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	101½	...
58,000	United River Plate Telephone, Limited	5	2½ — 3	2½ — 3	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	90 —100	90 — 100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	6½ — 7½	6½ — 7½	7¼	...
260,900*l*	Do. do. do. 5 p. c. Debentures	100	102 —105	102 —105	102½	...
30,000	West Coast of America Telegraph, Limited	10	2½ — 3½	2½ — 3½	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	102 —106	104 —108	...	...
64,242	Western and Brazilian Telegraph, Limited	15	7⅞ — 8¼	7⅞ — 8¼	8¼	7⅞
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	5⅞ — 6¼	5⅞ — 6¼	6¼	6
33,129	Do. do. do. 5 p. c. Deferred	7½	1⅞ — 2¼	1⅞ — 2¼	...	...
184,100*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	105 —108	104 —108	...	...
230,100*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	105 —108	105 —108	106½	...
88,321	West India and Panama Telegraph, Limited	10	1½ — 1⅝	1½ — 1⅝	...	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10½ — 11	10⅝ — 11¼	10 15/16	10⅝
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9 — 10	9 — 10	9	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	106 —109	107 —110	...	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125	120 —125	...	...
171,000*l*	Do. do. 6 p. c. Sterling Bonds	10)	103 —106	103 —106	...	...
69,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5½ — 6	5½ — 6	5⅞	...

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. Bank rate of discount, 2½ per cent. (January 26th, 1893.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7½—7⅞.—Brush Company 4½ per cent. Debenture stock, issued at 1 per cent. premium, 100—103.—Electric and General Investment, shares of £5 (£1 paid), 1½—2½.—Founders' shares, 200—225.—Electric Construction Corporation, 6 per cent. Debentures, 95—98.—Electricity Supply Corporation, Ordinary of £5, 5—5½.—Elmore Foreign and Colonial Copper, Founders shares, 6½—7½.—European Sims-Edison Torpedo Company, shares £20 (fully paid), 20—20½.—Founders' shares, 10—20.—Halifax and Bermuda Cable 4½ per cent. bonds 80—90.—House to House Company (£5 paid) 1½—2½.—Do. 7 per cent. Preference of £5, 5—5½.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5—5½, 1st Preference Cumulative 6 per cent., £5 (fully paid), 6—6⅛.—Liverpool Electric Supply Shares of £5 (fully paid), 5½—6.—Manchester, Edison and Swan Company, £9 (£1 paid), ¼—½.—Queen Anne's Mansions Lighting and Heating, Debentures, 101—103.—Woodhouse and Rawson £5 Preference (fully paid), ¾—1¼.

‡ Unless otherwise stated all shares are fully paid.

LEGAL.

TIBBITS *v.* ALABASTER AND OTHERS.

(*Continued from page* 188.)

Prof. S. P. THOMPSON said he was principal of the Finsbury Technical College, and for a long time had had much experience in electricity. With Harness's belts, not coupled up, no electricity could be obtained. He coupled some up and experimented, with result he found it made no difference in what way the discs were joined together. It was not possible to increase intensity by connecting the discs up. Another result was, that he found that the current of electricity was exceedingly small. With the dampest skin it was less than a fifth of a milliampère. That was appreciable with a fairly sensitive galvanometer. With the skin dry, the current would be perhaps the 200th part of that. He had no doubt a good part of that minute current went through the body. He should call it an infinitesimal current, considerably less than you could obtain by taking a needle and a pin, connecting them together, and dipping them into a drop of ink (laughter). If he had had to review the pamphlet he should have said, "This dear old doctor does not know what he is talking about." (Laughter.)

Sir RICHARD WEBSTER: And no one would have thought that a libel.

Prof. THOMPSON said it came to him as an utter surprise to hear that belts ever were connected up with an outside wire.

Cross-examined by Sir RICHARD WEBSTER: He began to experiment on these belts three or four weeks ago.

In the case of the pin and needle there would be no resistance?—I mean connected with wire.

What resistance?—It would be equal to a hundred miles of telegraph wire.

The resistance would be nothing like that presented by the human body?—No.

By how much?—It might be a couple of thousand times.

Or ten thousand times?—It depends so on the state of the body.

Dr. ARMAND DE WATTEVILLE said he had made a special study of electrical therapeutics. He had examined the belts. Supposing the belts were coupled up and applied to the body, in his judgment the current would have no therapeutical value at all.

Sir RICHARD WEBSTER objected. His medical evidence on that point had, he said, been shut out.

In answer to further questions by Mr. WALTON, the WITNESS stated that if the skin were dry the current would be practically nil. There could be no constant generation of electrical current by the belts. His experience in practice verified the conclusions at which he had arrived. The minimum medical dose of electricity would be three or four milliampères, and that must be applied to the diseased part.

Cross-examined by Sir RICHARD WEBSTER: That would be a current applied by machine for half-an-hour or an hour.

Is the blood metallic at all?—I have never heard such a question asked, and I cannot answer it. (Laughter.)

Dr. H. L. JONES said he was in charge of the electrical department at one of the London hospitals. He had examined the belts, and agreed with the observations of Lord Kelvin with regard to them. The minimum medical dose was from two to ten milliampères in most cases, to be applied for ten minutes.

Mr. GEO. WM. DE TUNZELMANN, an experienced electrician, said he had experimented with these belts. If you had zinc and copper in contact with the body, the amount of electricity passing through the body was insufficient to be of any appreciable value. He was speaking as an electrician. From the pamphlet of Dr. Tibbits, he should judge that that gentleman had only an elementary knowledge of electricity.

In cross-examination by Sir RICHARD WEBSTER, WITNESS said he had sent some notes to *Science Siftings*, but as far as he knew, no complaint had been made of his article, nor had an action for libel been brought in respect of it. If you put a zinc disc in the mouth, and held the copper in your hand, such an amount of current would pass through the body as could be observed on the galvanometer.

Mr. JOHN GRAY, an electrician, of Chancery Lane, agreed with the evidence of Mr. Kempe with regard to the effect of polarisation.

Mr. ED. C. DE SEGUNDO said he had examined a belt he bought at Oxford Street. He did not intend to buy a belt, but was persuaded to do so by the attendant, who said it would cure indigestion. (Laughter.) He was told that the moisture of the body would set free an electric current, which would pass through his body. The belt was given to Mr. Gatehouse, and experimented upon in his presence. As the belt was sold to him, and under the instructions given to him, the belt was electrically useless. There were no connections.

Mr. JUSTICE MATHEW: That has nothing to do with Mr. Tibbits Come to the experiments where there was proper coupling up.

WITNESS added that he was clear that no such printed instructions as had been referred to by Sir Richard Webster were given to him.

Mr. WALTON called for the patentee's description of Mr. Harness's invention.

Mr. JUSTICE MATHEW excluded the evidence on the ground that the defendants had criticised what was described in the pamphlet, and not the specification which told how Mr. Harness's belts were made.

This closed the evidence.

Mr. WALTON, in reply, said that in the first place, an advertisement had been put in evidence which showed the nature and character of the belts as they were being sold to the public. The defendants had to defend their description of the belt and their criticism from the pamphlet. It was clear that the belt Dr. Tibbits operated upon was without outside metallic connections. In order to determine whether the defendants were liable for having passed the bounds of fair criticism, they must consider not what Dr. Tibbits had before him, but the inference that the defendants would draw from what Dr. Tibbits himself had said in describing the belt, and from what knowledge they could derive by enquiry at the establishment in Oxford Street. Sir Richard Webster had had ample opportunity of showing that these belts were supplied with these outside connections, but he had not done that, and he had even failed to show that the public were in a position to know what the connections were for. If the sockets on the belts were not intended for the purpose of coupling with batteries, why was the connecting wire not permanently fixed on instead of being left loose? He submitted that the evidence showed that Dr. Tibbits was mistaken in saying that these belts had outside connections, or that his experiments and his description of the belt were altogether impossible and absurd. One of the plaintiff's own witnesses had proved that he had got his belt without outside connections, and why were they to assume that Dr. Tibbits got his with them? The defendants assumed, and he asked them to assume, that without connections was the ordinary method in which these belts were supplied to the public. What was the electrical result which these people got for their five guineas? It could only be detected by an extremely sensitive galvanometer, and was not equal to that produced by a needle connected with a pin and dipped into a drop of ink. (Laughter.) What was the position the defendants took up? They had not referred rudely nor too severely to Dr. Tibbits. They had hit at the appliance and the sale of a trumpery article, and the man they wished to draw into that Court was the man who had thought it convenient to keep in the background and out of the witness box, and to put forward Dr. Tibbits to fight the battle of the belt. (Laughter.) The plaintiff was responsible for lending his name for forwarding the sale of an invention which the defendants had good grounds for saying had absolutely no value, and said they thought it was a case for the intervention of the medical authorities, to prevent the sale of a worthless article. He (the learned counsel) trusted the jury would find his clients had not exceeded the right which, so long as it was exercised honestly, was a valuable privilege to all of them—namely, that of bold and free criticism—and that they would not by their verdict allow Mr. Harness to get an advertisement out of this matter, when Dr. Tibbits's loss (if any), at the most, could be counted by farthings. Other things had been said with reference to the plaintiff's writings with regard to which he had not been so sensitive, but when Mr. Harness was at his back, and these inventions were at stake, he had allowed himself to be put forward. In the circumstances, he asked the jury to return a verdict for the defendants on the grounds he had stated.

The Court adjourned.

THIRD DAY.—FEBRUARY 17TH.

The hearing of this action was resumed.

Sir RICHARD WEBSTER, Q.C., in addressing the jury on behalf of the plaintiff, said his duty to his client, having regard to the extraordinary way this case had been conducted, and the very powerful and able address by his learned friend, rendered it necessary that he should bring their minds back to the real issue in the case. Might he say once and for all that he was not appearing there for Mr. Harness; he had nothing to do with Mr. Harness—he appeared for Dr. Tibbits. Before he sat down he would call attention to the way in which Dr. Tibbits was cross-examined, and to the effort which had been made to put upon him matters for which he was in no way responsible. No doubt the case had been conducted according to the instructions given to his learned friend, but he (Sir Richard) desired the jury to understand that it was no part of his case, as representing Dr. Tibbits, to criticise or comment upon anything the defendants might have said of Mr. Harness. They knew that there were other proceedings pending with regard to earlier articles, and it would be—subject to what his Lordship would tell them—a very great injustice indeed if, under cover of defending this action, the defendants should be allowed to turn the article in question into an attack upon Mr. Harness, instead of what he would undertake to show it was, an attack upon Dr. Tibbits. For when the libel came to be examined and regarded by fair minded men, he would point out that there was scarcely a word, scarcely a sentence, which was even libellous or slanderous upon Mr. Harness; the whole sting of this article was directed against Dr. Tibbits and against the medical profession as distinguished from Mr. Harness. He asked—and he was sure he should have their careful attention of the arguments so far as they commended themselves to the judgment of the jury—what were the facts? Prior to the end of 1892 Dr. Tibbits did not believe in the possibility of these weak currents going through the body. He confessed he was somewhat astonished at the argument which was used by his learned friend, Mr. Walton, in his first speech. Mr. Walton said that because Dr. Tibbits had not publicly recanted a statement in an earlier book, therefore the jury would be of opinion that Dr. Tibbits, for some reason or another, was a witness whose word could not be relied upon. The strength of his (Sir Richard's) position was this, that Dr. Tibbits—against whose honour things had been said which ought not have been introduced into this case, against whose honour no accusation had been brought or could be brought—had published in a series of medical works a statement as recently as 1888 that "For many years ingenious forms of so-called galvanic batteries chains, and bands have been recommended for various parts of the body. It has been said that a galvanic current generated through them circulates through the body. Worn as described the current never leaves them, for it always selects the best conductor, and the metal chain is many thousands of times a better conductor than the skin." Therefore he (Sir Richard) pointed out that so far from being a paid hack of these people to write to order, Dr. Tibbits had published his opinion, and stated, upon the strength of his medical knowledge and then experience, that these belts do not transmit the current into the body. He came then

to the first connection—and for the purposes of this case, the only connection between Dr. Tibbits and Mr. Harness. Of course, it was convenient to say that Dr. Tibbits was paid 100 guineas to write a puff; but such statements by whoever has the difficulty of defending actions for libel, were not to be taken upon the responsibility of counsel, but upon the facts. The jury had seen Dr. Tibbits in the box and heard his evidence, and in justice to Dr. Tibbits, he must point out (his Lordship observed it at the time) that Dr. Tibbits having stated that he declined to investigate the matter at all unless his report was accepted by Mr. Harness as it stood, there was no single word of cross-examination with regard to that. He (Sir Richard) had been twitted with not having called Mr. Harness; but if he had done so, not only would he have been wrong, but the evidence would have been irrelevant. Mr. Tibbits stated in the box, upon oath, that these were the terms upon which he had undertaken the matter, and the learned counsel for the defendants did not even cross-examine with regard to the matter, nor suggest, until all the witnesses for the plaintiff had gone out of the box, that he was going to make any such allegation. His Lordship would tell them, under those circumstances, that for the purposes of this case, Dr. Tibbits was entitled to have his evidence upon that matter believed. He hoped and believed his Lordship would let them see Dr. Tibbits's original report—not that which was subsequently published. Dr. Tibbits claimed to have discovered this with regard to the matter, and no more; he claimed to have demonstrated to his own satisfaction—however much the defendants might sneer, he would show later on that they had no ground for sneering—Dr. Tibbits claimed to have demonstrated to his own satisfaction that currents did pass through the body; not in the sense of going from side to side of the body, though he daresay they did that (for, as his Lordship said on the previous day, if the current got under the skin nobody knew what became of it), but through other parts. Dr. Tibbits proved to his own satisfaction, after six weeks of experiments, that the current, as he described it, penetrated the skin; and he claimed to have settled that currents did enter the body when carefully applied by means of such apparatus. That was the statement Dr. Tibbits made; and whatever Mr. Gatehouse might have said, that was the statement which was proved to be true by the simple admissions of Lord Kelvin and the other electricians who had been called; whether that fact was of value or not, attention should be drawn to a further point. Dr. Tibbits had been held up to opprobrium because he circulated, or allowed this report to be published, without pledging his opinion to the medical value of these currents. If there was anything which would have demonstrated the fair-mindedness and honesty of Dr. Tibbits, it was the statement he made on oath. It would have been in his favour if he could have said that they were useful from a medical point of view, but fortunately Dr. Tibbits did not require to eke out his case by any expression of knowledge of the practical working of these belts before proper tests had been made. Accordingly he said, "I have not had sufficient experience of these matters to say whether or not they are therapeutically of medical value." He made no complaint of the way in which this case had been conducted by his learned friend, because his Lordship ruled them all, and decided whether evidence was admissible or not. But it must not be forgotten that when he was prepared to put into the witness box medical man after medical man, and patient after patient who (rightly or wrongly) had believed in the efficacy of these belts, and had had personal experience of them, his Lordship asked if Mr. Walton objected. "Yes," said Mr. Walton. Therefore upon the invitation of the defendants that had been shut out. Why? Because in the opinion of the Court it was immaterial. They would see in a moment what the defendants had said. But before he came to that, he must ask them to remember, what the true facts were. He asked them kindly to understand the facts on the undisputed testimony. The facts he was going to read were those deposed to by Lord Kelvin. There could be no controversy that Lord Kelvin, from the great pinnacle of his scientific position, put exactly what Dr. Tibbits, with lesser electrical knowledge, and after five or six weeks of experiment, had discovered, and had told in his report which the defendants had before them. Lord Kelvin was asked: "If the belt were placed on a human body in a state of perspiration, and metallically connected, would a current flow?—Yes. a small current would flow.—In the absence of clothing between the belt and the body, would the body itself complete the circuit?—Yes. —Would the current flow from positive to negative pole through the body?—The current would certainly flow through the body, entering the body through the zinc surface, and leaving by the copper surface." He (Sir Richard) desired nothing further than that, and though the language of counsel, perhaps, was not so important, in justice to his client he asked the jury to remember that he opened that case to them specifically and distinctly. Mr. Walton and the defendants' witnesses had endeavoured to suggest that Dr. Tibbits wrote respecting belts that were not metallically coupled up; but no fair-minded electrician examining Dr. Tibbits's pamphlet could possibly have thought that for a moment. Nay, more, when the defendants' article was looked at it was perfectly clear that they were condemning Dr. Tibbits with reference to belts that were metallically coupled up. That could be demonstrated from the article itself. But what did they know now? His learned friend was instructed to cross-examine and suggest that Dr. Tibbits had meant to speak of uncoupled up belts, and that the merit, so far as Dr. Tibbits's pamphlet was concerned, referred to such belts. Mr. Walton actually went the length of saying that the defendants came into Court supposing they were going to attack nothing but uncoupled up belts. Unfortunately they called a perfectly respectable medical gentleman, and who produced an old belt. He (Sir Richard) asked to see it, and the witness admitted that there were permanent metallic connections between the zinc and the copper. External connections would not be found on that belt, because they were not needed, unless it was sought to apply some outside instrument if you had the internal metallic connections between the two. Accordingly upon the only Harness belt produced by the defendants there were the metallic connections which caused, and which were necessary to produce, any electrical effect at all. It did not stop there. If this libel had been to the effect that if the belts had been electrically coupled up there was a small current of no electrical value, he could have understood it. But this libel upon the face of it referred to what Dr. Tibbits had said in connection with a coupled up belt, and nothing else. The learned counsel then referred to the experiments described in Dr. Tibbits's pamphlet, which he claimed showed that a current of electricity penetrated the skin, and (on the admission of every single electrical witness) entered into and circulated in the body. He then argued that, however small the current generated and passed into the body might be, it was no sign of fraud for a man to indicate that such currents might have been of use. When a medical man says, as Dr. Tibbits had done in this very pamphlet, that the doses of these weak currents must stand the test of experiment, and that all he claimed was that these currents went through the body, he (Sir Richard) ventured to think it was unfair to impute to Dr. Tibbits professional misconduct, being party to a fraud, and being guilty of such unprofessional behaviour in this matter as would entitle him, practically, to be spoken of as a man to be driven out from the pale of honourable people and decent society. What was the libel? Whatever might be said about Mr. Harness, the sting and the whole pith of it was against Dr. Tibbits, and not against Mr. Harness. How was it headed? Was it headed "The Harness Institute," or "The Harness Belts?" No; but "Electricity and the Medical Profession;" and the only medical man mentioned was Dr. Tibbits. And yet, forsooth, his learned friends were instructed to say that they were not attacking Dr. Tibbits but Harness, that the article was a fair comment upon Harness, and that if Dr. Tibbits's name were introduced he had no remedy at law in respect of what had been said. The learned counsel then read passages from the alleged libel, especially relying on the reference to "the furniture salesman in direct connection with Dr. Tibbit's name," as proving Dr. Tibbit's was attacked. He directed attention (with the same object) to the suggestion that the British Medical Association should interpose. Passing on to the description of experiments made by the plaintiff, he claimed that it was obvious that there were connections (external or internal) in all the belts. He desired to make a frank apology for the statement made (on information) in his opening that *Science Siftings* was connected with the ELECTRICAL REVIEW. As a writer for *Science Siftings* had been called as a witness for the defendants, he did not know that it was a very improper thing for such a conclusion to be drawn by those who advised him in connection with this matter. The whole course of the defence had been to divert attention from the real slander, which he asked the jury to say was upon the medical profession in the person of Dr. Tibbits. It was not an attack on Mr. Harness or on the Harness Institute; it was an attack on Dr. Tibbits for being, as the defendants suggested, the abettor of a fraud. The jury had what Dr. Tibbits had written; and if honestly taken, it was no more than an honest professional opinion, absolutely disentitling anyone to say that he had been guilty of fraudulent conduct. He passed by the unworthy suggestion that because Dr. Tibbits had had to borrow money to instruct counsel, therefore this was not to be regarded as his action. Dr. Tibbits had sworn that the action was conducted by his own solicitor and brought on his own account. Dr. Tibbits had been unfortunate; he had been an enthusiast; but what had Dr. Tibbits's financial affairs to do with the article in the ELECTRICAL REVIEW? Dr. Tibbits had been slandered, he had been grossly libelled, and he had come forward because his professional reputation and the means of his livelihood depended upon his being able to stand before the world as he had always stood—as a medical man of unblemished reputation. It was an outrage that, under cover of scientific criticism, such aspersions should be made on the honour and conduct of such a man; and he asked not for vindictive damages but, the defendants having pleaded the plea of justification, to say that these aspersions on Dr. Tibbits's character never ought to have been made, that there was no justification for them, and by their verdict to give the plaintiff such damages as would re-establish his position in the medical world.

Mr. JUSTICE MATHEW summed up. He said the real question was one altogether for the jury. It was for them to dispose of the issue raised between the parties. The libel complained of was a criticism on a pamphlet published by the plaintiff. No doubt a newspaper writer possessed no greater rights than any one of the public, and any one of the public was entitled to criticise and express an opinion upon anything that invited public criticism, and as long as that opinion was an honest opinion, influenced by no improper motives, and within the limits of what a jury would consider fair, no action for libel would lie. It might be a very pungent criticism; it might be wholly disparaging; it might be very offensive; it might be cruel; but so long as it was an honest opinion, and an honest opinion on what was offered to invite comment, the publication was not a libel. If an author published a book—it had been the fate of most of us to see very disparaging comments on books that had been published very often—it was very often felt that what was said was very pungent, offensive, and cruel to him; but as long as it is honest, as long as the writer expresses his honest opinion, no action will lie. If further illustration were needed, they were all familiar with the way in which public men were spoken of in this country; they were accustomed to the denunciations of one party by the other as the enemies of their country; but so long as those opinions were honestly expressed, nobody could challenge them by an action for libel in a court of law —there was an end of it. But there was an admirably clear and well defined line beyond which the critic must not go; he might attack the opinions, he might attack the productions of the person he assailed, as long as he did it honestly; but he must not attribute unworthy or dishonest or improper motives to the persons whom he

attacked; if he did, the sole mode by which he could escape the responsibility of the libeller was by proving that what he had said was true. That was a distinction which would always be observed by a jury, and one which gave proper and sufficient freedom to the critic. The law being clear, they would see how it applied to this case. It was said on behalf of the defendants that this was a fair comment, an honest comment on a matter of great public interest, that it went no further than to condemn what it was their duty to censure in the conduct of the plaintiff. It was said for the plaintiff that the libel went beyond that, and charged him with being an impostor, and with aiding and abetting quackery: and if the plaintiff were right, and that were the conclusion to which the jury came in the examination of this article, the sole question would be, what damages the plaintiff was entitled to. That being so, he would refer for a brief space to the circumstances which gave rise to this litigation. It was suggested for the defendants that the real question sought to be thrust on the jury was not a question affecting the character of the plaintiff at all, but a question affecting the value of certain electrical appliances largely advertised and sold by a gentleman named Harness. It could not be got away from that the plaintiff in this action was not himself responsible for the action—the money was being found for him by the person referred to, Harness, the patentee of the appliances in question. They had had that view of the matter thrust before the jury from time to time in the course of the case, but it really had little to do with the matter in hand; they were not concerned with the question whether Harness's belt was a useful appliance or not. It appeared to him that any one of them would be justified in saying that this was a perfectly useless instrument; on the other hand, that any one of them would be justified in saying that it was an instrument of the highest possible usefulness. It was a question which could not be decided scientifically; it was a question of opinion. In the view of Harness and the view of the plaintiff, it would appear to be valuable; the view of the defendants emphatically was, that it was a thing of no use; that any utility that it had was derived from the lively imagination of those who bought and wore it. That being the condition of things with reference to the appliance in question, Mr. Harness, who was anxious of course to continue the sale already established, and increase it if possible, placed himself in communication with the plaintiff. At the time he did so a discussion had begun as to how these appliances acted, and the point they had arrived at was the very important point as to whether, if the electric current were generated by wearing this belt, it passed over the surface of the wearer or shot through his frame. If it cured him it did not matter which way it went; if it did not cure him, the inquiry was unnecessary. That point of discussion was reached. The defendants asserted in their paper—a paper of great authority—that these supposed currents must go over the surface, and never get beneath; Mr. Harness and those who were of his way of thinking asserted that electrical currents passed through the frame, and passing through the frame, swept out of it whatever the ailment was from which the wearer was suffering. That was suggested. None of us know exactly what electricity does. That being the state of things, it appeared to Mr. Harness very important to obtain scientific opinion, if he could, that this electricity passed through the frame and not under the surface. He placed himself in communication with the plaintiff, a man of high qualifications and considerable experience in the use of electricity for curative purposes. There was no doubt about that. He did not think any complaint could be made of the fact that it had been brought to their attention that, scientific as he was, he had not been successful in life. They must at the same time take his statement that any difficulties he had got into had been from the fault of others and not of his. He appeared to have established a benevolent institution which grew into something very valuable in more recent times; the public did not support him as he appeared to have deserved to be supported, and in consequence he got into difficulties, and was obliged to make first an assignment for the benefit of his creditors, and was afterwards driven into bankruptcy. That was his position. No doubt the suggestion was—and it was for the jury to consider how far the suggestion might fairly be made—that a man in that position was more approachable than a man in an entirely independent professional position. Certainly Mr. Harness applied to Dr. Tibbits to express an opinion on this point, the point at which the discussion at that time stopped, namely, the exact course taken by the electric current generated by this belt in question. It did not appear to be at all a question whether a current of electricity was generated, assuming of course that the belt be properly coupled up. It did not need an expert electrician—it did not need more than an ordinary schoolboy—to know that it must be coupled up if there was to be any electric current whatever. The position taken up by the defendants was that this current was so slight that it would be practically inoperative, and that if it had any operation at all, it slid along the skin of the wearer and did not enter into his body at all. Dr. Tibbits had very shortly before expressed an emphatic condemnation of appliances of this sort. They had had read from a book published as recently as 1889 what his view of these belts was. Nevertheless it was thought that with fuller opportunities of considering the question, a different result might be arrived at; but the Doctor had told them that he was very careful to intimate to Mr. Harness if he had a fee, that Mr. Harness must take whatever his honest opinion was; he was not going to be influenced by the consideration that he was bound to defend the cause as counsel would be who accepted a brief from a client. It was perhaps not wonderful under the circumstances, that the next, when it did appear, was not unfavourable to the client, because the pamphlet which had been referred to certainly seemed to him (Mr. Justice Mathew) to convey to anybody reading it that Dr. Tibbits's opinion of this belt was not an unfavourable one. In the box Dr. Tibbits was very careful to tell them that he had really formed no judgment on that subject, and that he could not pledge his professional opinion to the conclusion that it was a useful instrument. But it was said for the defendants that when he came to prepare that pamphlet he not only did not say that he had formed no judgment on the subject, but cleverly conveyed, by the form in which the original letter was written and by the quotations that followed, that this belt generated mild doses of electricity which were sometimes very useful, and that although their exact scientific effect was not understood, many that had the benefit of such mild doses had derived great advantages from them. It was for them to judge whether that was the effect of the pamphlet or not. The learned judge then read and commented on passages from the article in the ELECTRICAL REVIEW, dealing, first, with the following passage from Dr. Tibbits's letter to Mr. Harness:—"When I first asked you for the electropathic belt to experiment with, I did so with considerable doubt as to their generating electricity, but I am pleased to say that my investigations and experiments have most conclusively proved that they do generate it." What effect, his Lordship asked, was that likely to produce on anyone reading it? Then Dr. Tibbits praised the institution Mr. Harness had set up in Oxford Street. He said: "I desire to congratulate you upon the very efficient machinery and instruments you possess, and having during my inspection been brought into contact with several of your qualified officers and nurses, I can testify to the great value of your institute," &c. Then followed a very lengthy series of quotations from the book which had not been actually published (and had not yet been actually published), but which he described as a work of his on "Massage and Electricity and Allied Methods of Treatment." The effect of these was to point out that mild doses of electricity had been found to be very useful, and to suggest that this belt, when properly used and coupled up, did produce mild doses of electricity. That was a pamphlet that was published inviting public criticism, and it was sent to the proprietors of the ELECTRICAL REVIEW as well as others, that they might comment upon it. It was no doubt considered by Harness to be an extremely valuable testimonial for his electropathic belt, and for that reason sent to the papers for any fair comments that might be made upon it. It was under these circumstances that this alleged libel, this article in this paper, was published by the defendants; and they, the jury, had to say whether it was just to treat that article as honest criticism upon the pamphlet and the conduct of the plaintiff with reference to this belt, or whether it imputed to the plaintiff that he was an impostor, a conscious impostor, lending himself to palming off on the public an utterly worthless instrument. It was clear that the article was not expressed in that form; it did not contain anything which you could put your finger upon and point to as involving a charge of imposition upon the plaintiff; but it was said that anybody reading it would come to the conclusion that that was what was meant, and, if so, the article was libellous. It was agreed that the earlier part of the article—which was headed Electricity and the Medical Profession—did not, and do not, refer to Dr Tibbits. It appeared to refer very distinctly to the proprietor of the belt; and it was said that he had taken proceedings to defend himself against any imputation made upon himself in that or any other article published by the defendants. To come to the point, we have now before us, a pamphlet on "'The Treatment of Disease by the Prolonged Application of Currents of Electricity of Low Power,' by Dr. H. Tibbits, which we consider to be a grave reflection upon the intelligence of the medical profession generally, seeing that Dr. Tibbits is, we believe, supposed to be a recognised authority in the medical world." There was nothing unfair in saying, "Here is a gentleman who is a recognised, or supposed recognised, authority; we condemn him as we condemn the instrument, without saying that he is a conscious impostor." It went on, "The pamphlet is nothing more nor less than a direct recognition of the Harness 'Electropathic Belt' as a valuable electro-medical appliance." Was that a charge of imposition? Did it say more than that this gentleman, who was supposed to be an authority in the medical world, was lending his sanction, and giving the direct recognition of his opinion that this was a valuable medical appliance. "In the light of the trial in the Bloomsbury County Court, which we reported in our issue of July 22nd, and in which it was brought out that one of Mr. Harness's qualified medical officers who dealt with cases of hernia, was originally a 'furniture salesman,' the reference to the 'qualified officers' in the following extract from a letter to Mr. C. B. Harness should be noted. The extract is as follows:—

"'The West End School of Massage and Electricity
"'(Established 1886), London, W.,
"'*August 24th*, 1892.

"'I have pleasure in handing you an extract from my book upon 'Massage Electricity, and Applied Methods of Treatment' as to the value of mild currents of electricity in the treatment of disease.

"'When I first asked you for the 'Electropathic Belts' to experiment with, I did so with considerable doubt as to their generating electricity; but I am pleased to say that my investigations and experiments have most conclusively proved that they *do* generate it.

"'Now that I have been able to scrutinise every department in your establishment, I desire to congratulate you upon the very efficient machinery and instruments you possess: and having, during my inspection, been brought into contact with several of your qualified officers and nurses, I can testify to the great value of your institute to members of the medical profession who have cases suitable for treatment by electricity and mechanical exercises, as it is impossible for a private practitioner to ever hope to have the resources such an institute as yours commands.

"'I was also glad to see cases presented for treatment, diagnosed by your legally qualified medical assistants, and that strict clinical records were kept of the progress made, for it is only by practice and daily observance that electro-therapeutists can gain the necessary knowledge and experience.

"'Yours faithfully,
"'HERBERT TIBBITS, M.D., F.R.C.P., Edin., &c.'"

There was a disagreeable reminder to the doctor that he had praised these "qualified practitioners" at the Institute of Mr. Harness, and what was suggested was that it turned out on investigation in a court of law that one of those with whom the doctor was satisfied was nothing less than a furniture salesman. It was said by Sir Richard Webster "How offensive that is!" Dr. Tibbits referred to them as qualified assistants. What the defendants said was, "Before you praised people there as qualified assistants, we think you might have inquired what they were, and have ascertained whether or not they had medical qualifications." It was beside the matter, but it was used by the learned counsel for the plaintiff as indicating a malicious bias against the plaintiff. "As is usual in letters of this kind, there is one thing that is true in what is said, and this acts as a gloss to make appear to be true what is certainly, but not distinctly, false. The second paragraph, for example, literally speaking, asserts a fact which has never been seriously doubted, that the Harness belts when connected up *do* generate infinitesimal quantities of electricity, just in the same manner as does the old schoolboy experiment of placing a piece of zinc upon the tongue and a penny underneath and then bringing their projecting edges into contact. No doubt 'it is impossible for a private practitioner to ever hope to have resources such an institute as yours commands;' we admit that as the result of money accumulated by the sales of a great number of useless appliances an 'Institute' has been formed which may contain resources which, if honestly made use of, would be of real value, but there is clear evidence, we think, that the latter is not the object in view; the real object is to gild the counterfeit and make it appear to be all of sterling gold." It was said that the phrase, "the real object is to gild the counterfeit and make it appear to be all of sterling gold," referred to the plaintiff; it was said by the other side: No, it related to the person who was selling these things. It was entirely for the jury to say. Nobody could complain of the condemnation or laudation of these electric belts if the opinion was the honest opinion of anyone who commented on it. The next portion referred to experiments purporting to have been made by Dr. Tibbits. The doctor said, in effect: "I am going to establish that these currents pass through the frame, and not merely under the surface of the skin." Referring to his experiments, the doctor said: "I have tested many advertised appliances, and without entering into a long dissertation upon the relative efficiency of these, I have no hesitation in saying that regarded from a *strictly scientific point of view*, the electropathic appliances manufactured by the Electropathic and Zander Institute, who are manufacturers of Mr. C. B. Harness's various patents, 52, Oxford Street, London, *are preferable to any others*. By the courtesy of Mr. Harness, I have been permitted to test all his electrical appliances, and I give the result of my investigations. These appliances are *scientifically constructed*, perfectly manufactured, and admit of being placed on, upon, and kept in close contact with the skin, or with any part of the body." That did not imply to the observer that he had been paid the handsome fee of 100 guineas. Having described the belts, the Doctor said: "It will thus be seen that *either quantity or intensity* can be obtained." That appeared to be a very inaccurate statement, because although it might be a surprise to those who did not know anything about it, you could not, by multiplying the discs, increase the intensity. The plaintiff's explanation about that was that he was not considering this belt as worn, but that he was considering the belt as off the body; and if it were off the body that statement was true. But the sole question was what was the effect of the belt when worn, and he (Mr. Justice Mathew) could not think the plaintiff's explanation very satisfactory. Then the plaintiff referred to a diagram which showed the belt properly coupled up. From that diagram he proposed to prove that the current of electricity passed beneath the skin. The comment the defendants made was that there was no proof that the current passed beneath the skin, and on that point the evidence of the defendants appeared to be conclusive. Then the article went on to say, "A perusal of the foregoing by anyone who has a very elementary knowledge of galvanic electricity, and who has one of the Harness belts before him, will at once show that the writer exhibits a most incredible ignorance of electrical laws." Was it unfair to say that if it was an honest opinion, was there anything imputing dishonesty to a man when it was said that he was ignorant of electrical laws; and when that statement was accompanied with a proof which they proposed to offer of their statement? The plaintiff had had the opportunity of giving his version, and they had heard the evidence offered by Lord Kelvin and others for the defendants. It was for the jury to judge whether or not there was anything unfair or unjust under the circumstances in charging in strong language—they would not criticise language—if they thought the opinion was an honest and fair one, was the article libellous because it attributed to the plaintiff an ignorance of electrical laws? "An ignorance which utterly unfits him to speak as an authority, and which, in view of the support which it affords for the bolstering up of this appliance, seems to call for an interdiction by the British Medical Association." Sir Richard Webster said there was something which attributed to the plaintiff that he was bolstering up what the British Medical Association would condemn as quackery. It was said for the defendants, "All that we say about that is, that you express an opinion which would convey to the public that you thought it was a valuable instrument, and you thought so because the current of electricity passes through the frame, and you support your opinion by experiments. But to an electrician your proofs are no proofs, your experiments are fallacious, and, so far as they are used for upholding your opinion, you are bolstering up something which we say is a worthless instrument." They (the jury) must judge between the two. Did that impute to the plaintiff that he was bolstering up what he knew to be worthless, or was it more than a statement by the defendants that they were able to say that his experiments did not justify his position, namely, that an electric current passed through the frame. The article went on: "To go into all the points is unnecessary; we will simply refer to one or two. It is stated: 'It will thus be seen that *either quantity or intensity* can be obtained.' To this assertion we give a point blank denial; the discs cannot be joined up for intensity, and we wonder whether any elementary student would make the ridiculous assertion that a number of couples immersed in an electrolyte, contained in *one* vessel, would give more than the electromotive force of one couple." There the suggestion was made that the plaintiff was ignorant. That was the defendants story, but Sir R. Webster said that suggestion was that the plaintiff was a rogue. The jury had heard the evidence called to show that that statement of the defendants was true; that you did not increase the intensity of the current by multiplying the discs. That pointed to what was coming. "Everybody knows, or is supposed to know, that muscles, tissue, blood vessels, &c., are comparatively good conductors compared with the epidermis, but the discs on the Harness belts are not furnished with platinum needle points one-third of an inch long, for the purpose of puncturing through the skin, and thus, in a mechanical way, getting over its highly resisting properties. Surely such a subterfuge is too transparent to deceive anybody of ordinary intellect; but we think it incumbent upon the editors, considering the powerful influence exerted by such serials as the *Lancet* and the *British Medical Journal*, that they should bring this latest phase of the electropathic belt business before their readers." Was that saying anything more than "You do not know what you are talking about, and anybody with ordinary intellect would not be deceived by what you are saying." The article proceeded: "All persons conversant with the extraordinary sensitiveness of the Lord Kelvin—or as we prefer to have it—the Thomson reflecting galvanometer, are perfectly aware that *several degrees* mean *practically* no current. A piece of zinc and a platinum needle will produce all the effects stated above, without the intervention of the belt worn upon the body; indeed, the absence of any indication that the negative pole of the belt was connected to anything at all, it appears perfectly evident that the belt, *per se*, played no part in this little 'Comedy of Errors.' What value, we would ask, is the bare statement that 'a deflection is obtained on a galvanometer?' The introduction of the term 'Lord Kelvin reflecting galvanometer,' is a pretty transparent device; the public will at once say, 'Oh, if we get evidence of an electric current on a *Lord Kelvin* instrument, of course the appliance producing the current must be a most valuable contrivance, and cheap at several guineas.' Such is the public logic (?), and, unfortunately, those who trade thereupon know it. With all the rubbish (to call it by a mild term) written, the concluding paragraph follows as a matter of course." Lord Kelvin said that his was a delicate instrument, and that what would be practically no current on the human frame would be observable on his galvanometer: "To get at the public, so as to protect them, is most difficult; the daily Press is, unfortunately, too interested from an advertisement point of view, to enter into the matter. We are pleased, however, to note that *Science Siftings* has entered the arena to do battle against this imposture. We heartily wish it success, and although it may take time, we feel little doubt but that perseverance will eventually command it, and that what is, undoubtedly, a grave scandal, may at last be unveiled in all its grossness, and the promoters and abettors brought to book." Sir Richard Webster said that was a comment directly pointing to the plaintiff; it was said by the defendants that it was fair observation; they considered it a useless instrument, and considered it was being put upon the public by means not legitimate, and they trusted in fulness of time this would be proved. It was said for the defendants: "We say this is a fair comment on matters of public interest, written honestly; it is not suggested that there was any quarrel or reason for our feeling any enmity, and we ask the jury to protect us when this libel is brought." It was said, on the other hand, that anybody reading this would suppose a distinct attack was made on the personal character and honour of the plaintiff as a medical man, and therefore he was entitled to damages. If it came to be a question of damages, a great deal might be said about this. If the jury thought the article had gone beyond the limit, probably they would think it very close on the line. Sharp, pungent criticism did not make libel. If this was an honest expression of opinion on which honest opinion was challenged by the plaintiff himself, the defendants were entitled to a verdict. All the circumstances of the case must be considered. Further it had been dwelt upon that this action was not brought to relieve the character of the plaintiff from any professional stain, but with a view of recommending to the public appliances of which the plaintiff had approved, and from which Mr. Harness was drawing large profits. The jury must consider if it were a question of damage by what figure they marked their sense of any wrong they considered had been done by the defendants to the plaintiff.

The jury having consulted for a few minutes returned a verdict for the defendants.

The announcement was received with loud and long applause by the people sitting in Court.

Mr. JUSTICE MATHEW advised the crowd to go away quietly before he had to send them. (Laughter.)

Mr. WALTON: I ask for judgment for the defendants, with costs.

Mr. JUSTICE MATHEW: Yes.

LANG *v.* HOUSE-TO-HOUSE ELECTRIC LIGHT COMPANY.

AT the Brompton County Court on Friday last, his Honor, Judge Stonor, assisted by a jury of five, heard an action, said to be the first of the kind tried in London, bearing on the responsibility of electric lighting companies to their *employés* under the Employers' Liability Acts.

Mr. Lynden Bell, instructed by Mr. A. Slater, solicitor, of 70, Finsbury Pavement, E.C., was counsel for the plaintiff; and Mr.

Ruegg, instructed by Messrs. W. Hurd & Son, solicitors, 25, Bucklersbury, for the defendant company.

Plaintiff, the widow of Thos. Piercy Lang, a labourer, sued the House-to-House Electric Light Supply Company, Limited, under the provisions of Lord Campbell's Act, for the benefit of herself, Edith Welcome Piercy Lang, aged three years, and Harold Piercy Lang, aged one year, the children of the plaintiff and her deceased husband, for personal injury caused to him as a workman in the employ of the defendants, leading to the loss of his life on November 9th, 1892, by reason of a defect in the condition of a warp, works, and plant connected with and used on defendants' premises. Plaintiff claimed £300 damages, and alleged that the cable which the deceased was handling at the time of his death was not properly or sufficiently insulated, by reason of the neglect of the persons in the employ of the defendant company who had the superintendence entrusted to them, while in the exercise of such superintendence, especially in permitting the adoption and employment of a bad and dangerous system under which the company's workmen were permitted and required to handle, without gloves, a live cable under a high voltage, and in directing and permitting the current to be turned on whilst the deceased was at work on the cable.

Mr. LYNDEN BELL, in stating the plaintiff's case, after giving the above details, stated that it would be necessary to go into the matter at some length, as it was not an ordinary action, and it involved a comparatively new agent, viz., electricity. The deceased husband of the plaintiff was working for the defendant company, assisting in laying an electric light service from the main cable to a house in Roland Gardens, Kensington. Whilst thus engaged, his hand came in contact with a wire, through which the electric fluid was passing, the result being practically his instantaneous death. The learned counsel produced and showed to the jury a specimen of the cable thus used, and said they would see that it contained five wires, and was covered by gutta-percha, with layers of India-rubber between the wires. The application of electricity for lighting purposes was a comparatively recent invention, and as it was known that criminals in America were now executed, not by hanging but by means of electricity, it became of great importance that those engaged in its use should be protected from the fatal consequences which might result were not precautions taken in respect to those engaged in the work of dealing with the wires and laying on electric services. Now the husband of the plaintiff was an ordinary labourer, that is, he had no special knowledge of electricity; he was about 22 years of age, healthy and strong, and was engaged by the defendant company at a wage of some 25s. per week. Working at the necessary duty for supplying this house with electricity, he was stooping down dealing with the wires communicating from the main in the road to this residence, and was drawing in what was called the slack, which was a part of the work of joining the branch supply to the main, when, it would seem, his hand touched a portion of the wire from which the gutta-percha had got free. Being seen by one of his fellow workmen in difficulties, he came up, and the poor fellow being unable to disconnect himself from the wire, his fellow workman broke it, thus severing the connection with the electrical current, and Lang fell back practically dead, for he lived only a few minutes. There was no doubt whatever that his death was caused by this electric shock, and the question for them (the jury) to consider was whether this was due to any neglect on the part of the defendant company. First, it was the case for the plaintiff, who had been left with two children dependent on her through this occurrence, that there was a defect in the defendants' plant, by reason of the cable not being properly insulated; and this action was brought to secure compensation to the plaintiff and her children. There was an inquest on the body, at which he believed it was proved the wire was not insulated, in the sense that by some means the gutta-percha had been rubbed off; but the accident occurring some little time after 4 o'clock on a November afternoon, it would be quite impossible in the darkness for a man to discover such a fault, and so if they held there was this fault in the insulation of the wire, he should submit to them that the negligence would be wholly that of the defendants, and the plaintiff would not be contributory to it. Defendants might have discovered this defect had they taken proper precautions to that end. They had, he supposed, a test by which they could tell whether or not the insulation was complete, and had any such plan been in operation before this unfortunate man's death, it would not have occurred, as the defect would have been discovered and he have been warned. Secondly, they said that the whole system under which the defendants' work was carried on was a dangerous system. Although electricity might be said to be in its infancy among us, yet new discoveries and new methods of applying it were constantly being made. It was not so long ago that, the current being supplied at what was known as low tension, there was considerable loss and waste in lighting small houses where a small power only was needed; but under the recently discovered high tension plan working up to, say, 2,000 volts, this waste could be avoided, and yet the power be fully utilised. Up to 200 or 300 volts, he believed, it was practically safe to touch the wires when charged with electricity, but at 500 volts it would kill a man. This high-tension system, therefore, while no doubt more economical and an improvement on the old, was much more dangerous to life. Hence it became not merely a moral, but it was a legal duty on the part of electrical employers to take every possible precaution for the protection of their workmen, and to secure them against the danger of handling these wires. This would obviously be peculiarly the case with regard to such a matter as electricity. Here was this poor man, having no very clear knowledge of the power he was using, entrusted with a dangerous task, for all electricians would know that a force of 2,000 volts rushing through a cable would be fatal to whoever touched it, unless it was properly insulated, and there was always a possibility of the covering round the wires being abraded, or rubbed off, or perishing, when subject to certain atmospheric influences. He should call experts before them to speak to these points, and witnesses to prove other matters which he should submit threw responsibility on the defendants for this man's loss. He believed it would be admitted that the current of electricity in the cable on which the now dead man was engaged was turned off about 11 o'clock in the morning, and was turned on again in the afternoon, before his part of the work had ceased, with that of a man named Young, charged, as they were, with connecting the house with the main.

His HONOUR remarked that the particulars filed in the action did not say who Young was.

Mr. BELL said he was in charge of the work.

His HONOUR: A superintendent over others?

Mr. BELL said: Yes; a man whose orders Lang was bound to obey. He admitted this ought to have been stated in the particulars, which were also deficient in some other points, but they had not the facts before them at the time of the particulars being drafted.

Mr. RUEGG said there was also another man engaged, named Taylor.

Mr. BELL said there were omissions which he hoped to correct as the case proceeded. The answer of the company to the plaintiff's submissions, he believed, would include a charge that this unfortunate man did not obey their orders to wear India-rubber gloves when handling these wires. Of course, the poor fellow was not here to answer for himself, and state the exact circumstances as they occurred. But he should call witnesses to prove that he had no rubber gloves to use, and that system was not introduced until after the accident, and the men had thus worked under the highest officials of the company, and when one of them asked for gloves he was told there were none on the work. They would also find, he thought, that Young was not wearing gloves at the time. Should the defendants strictly prove the gloves were provided that would be a different thing; but he should have to call for strict proof, as it was quite possible that Young's not having gloves on would be due to the fact that none were provided. Defendants were also, he believed, going to rely on the fact that a special notice of warning to the men engaged on this work was given that they were to wear gloves. He had a copy of this note; it was a little ambiguous, and not particularly clear, and read thus:—

"Sir,—Under no conditions must any part of any high tension main be touched while the current is on, and no work of any description is to be done on the main, or the instruments connected therewith, without using the rubber gloves provided for the purpose."

There was here, then, a conditional warning, not that the men must always use rubber gloves when doing their work, but only when the high tension was on. It was admitted that during the greater part of the day this work was being carried on with the current off, and a man might naturally suppose it would so remain off, unless he were told the contrary. If the defendants rely on this point, they will have to show not only that gloves were provided, but that the deceased man worked without them, and that they were provided at a main which he knew, and ought to have known, was a live main, with a high tension current on. And as the current was turned off for many hours during the day, the deceased could not be said to have infringed the rule, which only provided that he was to work in gloves when the high tension current was on. That was to him (the learned counsel) the plaintiff's answer to this notice. He should not attempt to work on their feelings by describing what was involved to the wife and children by his loss. But when they came to assess the damages, he would ask them to bear in mind all the facts—the age, strength and health of the man, and to say what figure it was reasonable the defendant company should pay to those whom he had left behind unprovided for; his wages, though not high, being sufficient to meet the wants of such a household as they would form. He asked them to come to the conclusion that the defendant company, having for the purpose of profit—a legitimate aim he did not deny—adopted a new system, more economical, but involving greater risks than the old plan, were bound to take such precautions as would protect their workmen, and prevent such calamities as that which had led to their being called together that day to pronounce their verdict upon it. The learned gentleman then called

Mrs. LANG, who, in answer to his questions, said she had been married to her now deceased husband four years. He was 22 years of age, strong and healthy, and received 25s. a week, with, sometimes, extra wages, and was the sole support of witness and their two children.

Cross-examined by Mr. RUEGG: She was at the inquest on his body, and had heard the evidence given. She went to the company and asked the superintendent to assist her. She denied that she had said she did not approve of an action being brought against this company. He asked, would she accept some money, and she said Yes; but she had no solictor, and she'd rather put off deciding upon it until she had asked a relative his opinion.

Re-examined: The solicitor on the other side came to see her. She was told that a subscription had been got up for her, and if she went on with the action she would not get the money nor had she received it.

Mr. W. R. PAYNE, an electrician, said he had been in the employ of the defendants up to last October. During that time the high tension system was in operation. Gloves were provided for use about June of last year. He had worked at the main on which deceased was working. There was one pair of rubber gloves provided. Before the issue of the notice they wore leather gloves. He never put on a pair of rubber gloves. He received a shock one morning, and asked Mr. Taylor, the foreman, for rubber gloves, and he replied, "You're all right; if you don't care to do the work somebody else will." High tension work could not be done without gloves. He didn't consider it was safe, with gloves or without them, to work on a live wire under high tension. He had himself never worked on a live copper wire.

Cross-examined: He had been working on electrical work some two years. He described a specimen of the wire produced, and pointed out the means of insulation. It would be an impossibility to make a joint in a live wire; that was what he meant by saying you could not work on a live wire. He had many times moved and pulled them about when alive. He understood the current could not be stopped under fine by the Board of Trade, but there were means of making short lengths of wire dead. To make a joint as they had been doing when deceased met with his death, the main cable must be slack, not taut. He described the processes of slacking and coupling, and said the wire was alive when the slack was pulled back. He supposed deceased got his fatal shock when so pulling the slack back. Deceased ought to have put on gloves; but if he had no gloves, how could he use them? The cables are laid through on iron pipe; he should not attribute the rubbing off of the insulation to its contact with this pipe; though it might have been pulled off while the cable was being pulled in. He had never known it so happen. He should not like to say it was "impossible" for an accident to happen if rubber gloves were used; but he certainly thought it improbable. He could not suggest greater precaution against non-insulation than the five coatings given to this cable. Was sure he only saw one pair of rubber gloves; the same pair was passed from Mr. Young to Mr. Taylor. On his oath, Mr. Taylor had refused him rubber gloves. It was a matter of talk that having the notice about gloves sent down to them, no gloves were available. He denied that he had ever made light of the warning given in the notice, or suggested the gloves were not wanted.

Re-examined: He could not tell by merely looking at or touching the cable, if properly insulated, whether it was or was not alive.

Mr. JOHN HAYLING, engine driver in the employ of defendants, said he had no rubber gloves to use in his part of the business. The current on the day in question, after being taken off about 11 o'clock in the morning, was switched on at 3 p.m. from the head office. He described the blocking and switching on of a main.

Cross-examined: His engine would be going night and day, and he only knew of the block by the electrician's order. He had only seen one pair of rubber gloves in use on defendants' premises.

Mr. EDWARD C. DE SEGUNDO, consulting electrical engineer for about 8 years, Associate of the Institution of Electrical Engineers, and for some time connected with the London Electric Supply Corporation, and with others, in laying down electric cables, described the mode of supplying electricity to private houses, and said the cable must be slackened for connection. This being made, the slack would be hauled in, and to ensure this being done properly, the insulation should be of sufficient strength. Apart from the hauling, he should not consider the wire produced (corresponding with what was handled by the deceased man) sufficiently thick and strong to carry 2,000 volts; the India-rubber was insufficiently strong, and it would probably enough be rubbed off in hauling. Most certainly a thicker coating of India-rubber was customary under so high a pressure. It would certainly not be safe to allow men to work on a live wire of such voltage. Given that the gloves were in proper condition, they would be a protection in handling the wires, but the men had to use pliers, knives, and other tools, and the gloves might easily become unsuitable as a protection; and under no consideration whatever, he thought, should men be put to work on live wires. There were means for cutting off the electricity from a portion of a wire, and there was no necessity for any danger to attach to the communication of live with dead wires. He saw no difficulty in arranging for turning off the electricity when connecting a wire to private houses with the main cable.

Cross-examined by Mr. RUEGG, he said he depended on no particular system of electrical service; he appeared as a general expert in the science and its application. Being shown the specimen of the wire in use when the accident occurred, he said he should be surprised to hear that it represented 5,000 megohms per mile, and he still doubted it. He thought gloves not necessary except when dealing with a live cable; in fact, he did not admit they ought to be used at all, for he thought, to be on the safe side, no live cables should be handled.

Mr. RUEGG: You think your system better than other people's?—Not at all; I have no system. If gloves were in a good condition he did not see how injury could follow, except, indeed, they were wet, and there was leakage anywhere through them to the hand.

Asked did he know that, as a matter of fact, men often handled wires with the bare hands, he replied: What, when the current is on? If they do, they do it at their own risk.

But if you have gloves, is it not a double security?—Certainly it is, assuming that the gloves are in good condition.

Would there practically be any danger in handling a cable like this if the gloves were perfect?—Not if the insulation were perfect; but if you had the gloves on you would find it somewhat difficult to catch hold of so small a wire as that.

Were you told about the joint?—I was told a joint had been made just before the accident, and that it occurred while the deceased was handling the slack.

Would you consider it proper to pull it in without putting on the gloves?—I think it would involve risk to human life, and such risk ought to be avoided.

Have you ever known an accident of this kind before?—Not to my knowledge. I have heard of men getting shocks through the gloves being abraded or torn, or something of that kind. They run wires overhead with a higher voltage than this and no insulation, but men would not touch them, gloves or no gloves, unless the current was turned off.

You agree there is practically no risk in pulling in the cable with gloves on?—I do, provided the insulation on both sides is perfect. He had never, himself (he went on to say, in answer to questions by the learned counsel), had to specify for a wire of 2,000 volts, though he had had experience of lighting with such a voltage.

Re-examined: A fault in the glove of the size of a pin's hole would render it useless as a protector.

His HONOUR: I understand it is admitted the dead man had not gloves on. Is there, then, any practical use in keeping up this line of examination?

Mr. LYNDEN BELL said he would content himself with asking were there not regulations by the Board of Trade applying to insulation and voltage, and the like; and the witness said yes.

If you were called on to specify for a cable of 2,000 volts, would you specify for a wire like that?—I should specify for 5,000 megohms.

Mr. C. H. YEAMAN, Associate of the Institution of Electrical Engineers, and for some years electrical engineer to the Liverpool Corporation, examined by Mr. LYNDEN BELL, was asked did he consider it was safe for the deceased to be handling a live cable, and he replied that he did not consider it safe for any ordinary working man to do so. He drew a distinction between such a man and a skilled electrician, because he thought it very unlikely that an expert would do such work as deceased was engaged on at all. Although he had himself handled live wires scores of times, and suffered no ill effects from it, he would not allow a working man to do so.

In the case of a man receiving 25s. a week, would you consider it safe?—No.

What would be the proper way to do this work?—To take the supply off the cable during the whole period the workman was engaged on it. The plan I have adopted myself has been to place a man in charge, and allow nobody to interfere with the switching gear but him.

In answer to His HONOUR, the WITNESS said that the Board of Trade, while requiring practically a constant supply of current, gave authority to turn it off for temporary purposes, either at the head or sub-stations. Once turned off, it should not be put on again until the foreman in charge saw it was safe to do so.

Examination continued: He would connect a live wire himself, and had done it hundreds of times, but he would not allow an ordinary workman to do it.

Now, look at that wire. We have heard that it carries 2,000 volts. Would you consider its insulation sufficient to bear that, or should it be better—stronger and thicker?— I think the insulation is sufficient, provided the wire is placed where it won't perish very rapidly, and it is not pulled about too much mechanically, as the rubber is subject to be worn off when this is done.

Cross-examined: He said he had had 7 years' experience, partly with the Liverpool Corporation. He knew of no better test than the vacuum tube. Had his hundreds of handlings of live wires been with bare hands? he was asked, and he replied he had made a joint in a live cable with 2,000 volts on it.

That was risky, wasn't it?—Not in the least; I admit no risk with the precautions I took as an electrician.

What were they?—I insulated myself before I took hold of the copper. He had used gloves, not with the cable, but as a precaution in handling porcelain switch handles.

Assuming that the deceased had worn gloves of that description (pointing to a pair of India-rubber gloves which had been shown during the evidence), and the cable was insulated, would there have been any risk?—If the gloves were in good condition, and clean, there would be no risk.

You now say, clean?—Yes. I have been knocked down myself when wearing gloves, through their being covered by dust or dirt in the course of lying about; and it would be about 500 or 600 volts that knocked me down. Questioned as to what course was pursued in these matters on the London Electric system, the witness said if they were dealing with a 10,000-volt cable they would stop the current before touching it, and with 2,000 volts they might do the same, though he imagined that if it was an urgent case they might make a joint with the current on, sending, however, one of their electricians to do it.

Is not drawing in a live cable often done?—Not by working men, or by them only as an exceptional thing, I should say. At Prescot, he kept gloves for himself and those in the station, but never sent them out to the men.

Re-examined: He said that he should not consider it safe to put an ordinary labourer to make a joint in a live wire with high tension.

Mr. GEORGE LEONARD ADDENBROOKE, for several years connected with the United Telephone Company, having for two years the greater part of their service under his charge, and testing and electrically supervising their cables, besides being connected with the installation of the Grosvenor Gallery, said he considered it most dangerous to handle a live cable in the way it was said to have been done here, and specially in handling it, because of the danger of unrevealed faults revealing themselves consequent on the strain. There appeared to him no difficulty whatever in so arranging for communication between the main cable and a branch to a private house as to involve those making that connection in no danger, and he thought that, save in cases of special urgency, no work should be done on a live cable. Asked if he considered the insulation of the wire produced sufficiently strong for 2,000 volts, he said no, not for the purpose required, by which he meant the inevitable effect of hauling in the slack with the action of the atmosphere and the like causes on the rubber. Personally, he should not allow less than double the thickness of the rubber used on the cable dealt with by deceased; and he should have had a larger copper wire than it contained.

Do you consider, gloves and insulation notwithstanding, it is dangerous for an ordinary working man, having no technical knowledge, to handle a live wire?—I certainly do; the more so as I consider it unnecessary under all ordinary circumstances.

In cross-examination, WITNESS said this cable had to be pulled about 44 yards, and some two feet of it close to the box would be peculiarly liable to abrasion. Many experts went so far as to say there was more risk with gloves than without them, as they tended to make

the user of them careless. As far as he knew, this was the first case of the kind which had happened in the precise circumstances experienced here.

This concluded the testimony for the plaintiff.

Mr. RUEGG at once proceeded to call witnesses for the defence, reserving his observations on the defendants' case to a later stage, when their testimony had been heard. He first called

Mr. ALBERT GAY, the electrical engineer and manager of the company, who said he had had nearly 12 years' experience in electric lighting and had the entire control of the company's works. The cable was manufactured at Silvertown, a factory having the highest repute in this country for that class of work. It was based on their best list, and ordered to be insulated not only on the highest power they make it, 5,000 megohms, but with an extra covering, for which the company paid a proportionately high price. He described the company's method of construction of their system and distribution, and quoted the regulations of the Board of Trade bearing on a constant supply, save for necessary repairs and short stoppages in making connections, with the company's methods in making joints and stopping the currents for the purpose.

Did it come to your knowledge (asked Mr. RUEGG) that your men were in the habit of pulling through the slack of live wires with their hands?—Certainly not, answered the Witness, who went on to explain that, following a conversation with the engineers, he thought it well to take special precautions against carelessness, and so he wrote the letter or notice which had been already read, although all that it said had been made well known before verbally, and in some cases by writing, thereby, however, in addition to what the learned counsel had read in his opening address, this closing paragraph in the letter:—

"Great care must be taken to see that these gloves are in proper condition before using."

This letter was sent to the men whose duty it was to deal with the mains, and those dealing with the high tension had printed instructions. Gloves had been in use some two years, and when the letter was written some extra pairs were obtained. It was absolutely incorrect to say there was only one pair available; he knew of at least four pairs, and he believed there were half-a-dozen of them. He should say there would be no risk whatever if the gloves were used, the regulations were adhered to, and the man saw that the rubber gloves were in a proper condition for use. He himself had worked on live cables and actually connected them, with the rubber gloves on. Taylor, Young, and the deceased were sent out to do this work, Taylor being the foreman of the work, and Young the man who made the joint.

HIS HONOUR: Do you call anyone to show that these men wore gloves?

Mr. RUEGG: Yes.

Mr. LYNDEN BELL: We say the current was turned off some time during the morning, and the men at this time thought it remained a dead cable.

Mr. RUEGG: Why, he himself had the current put on.

WITNESS was then examined as to the ordinary stoppage of the current whilst a joint was being made. The main might be blocked for a few minutes, but as a rule it would probably be put on without loss of time and run through. Did he know how the insulation could have been rubbed off, as it evidently was, witness was asked; and he replied no, it was very difficult indeed to say how it came about.

Cross-examined by Mr. LYNDEN BELL: The cable was resting on iron pipes?—It was inside an iron pipe, but it did not follow that it rested on it.

Well, might it not lie on the lower part of the pipe; did you see the spot where the rubber was removed; did it seem to have been removed a long time or to have been gnawed by rats or mice or rubbed off?—It would be impossible to conclude how it happened, as at the moment intense heat would be set up in the cable, the man's hand was charred, and the rubber would be burnt. The hauling of the cable would be necessary in making a joint.

And you know that would be likely to rub away the insulation?—Witness did not know that it would; he shouldn't think it would.

How was it considered necessary to have the insulation stronger than the best produced at Silvertown?—Because as the cable would be a mile or a mile and a half long, there might be abrasions in the ordinary course of working it. People who manufactured these things were likely to be better judges of the best insulation than he.

Then you left it to them?—Undoubtedly we did.

Did you tell them you thought it might be liable to considerable abrasion because of its length?—Certainly.

Had he ever seen a wire with more abrasion than this one?—To the best of his knowledge he had not.

By giving notice to the Board of Trade they had power to cut off a section?—Yes.

And he recognised that, to ensure a man's safety, a wire should be dead?—It would be better that it should be so.

Danger would be avoided by ceasing to work at the wire after the current was again turned on?—Yes; when the current is again turned on is entirely for the men themselves; they say when they have finished. We can discontinue in a section, not on a whole main, which is an entirely different thing.

Where would have been the difficulty of only turning it on when the work was complete?—The man who did the work gave notice that he was ready.

Do I understand your system is not to allow men to work on a live cable?—Not without gloves. At times it is absolutely essential to work on live cables.

Young, the WITNESS went on to say, received rather higher wages than Lang—32s. or 33s. a week; he had been with them longer. Taylor was a young man of from 18 to 20.

Wasn't Lang a labourer?—No; he was an assistant jointer.

Didn't he do what he was told by Young?—He was a younger man, and coming on later than Young, he would have to assist him. It was Taylor's duty to see the work of jointing complete before the current was put on again, and he would go to the cable with one of the men and see the connection was completed.

Mr. JAMES SWINBURNE, of the firm of Swinburne & Co., electrical engineer, and member of the Council of the Institution of Electrical Engineers, said his firm had exceeded 100,000 volts in the cables they had made. As far as he could see, this cable was well protected with a good rubber covering. Its makers had perhaps the highest repute for their cables. It would be perfectly safe to handle a live wire like this with India-rubber gloves, and it was continually done. No doubt there was some risk; but so there was in most things electrical. These gloves were made for the express purpose, and he himself always used them, as did his assistants. He thought that if the deceased man had worn gloves, he would have been absolutely safe. A joint could be made in a live wire, but it was not advisable to do it. You cut out the part where you want the man to work, and then couple it in again; but you can't couple it in without making it alive. What the defendants had, he understoood, was an insulating switch. He should certainly work with gloves, and he saw no reason why they should be left off when making a coupling. He thought the company acted very well and wisely in the matter of giving instructions to their men.

In cross-examination, he said it was dangerous to make a joint while the current was on.

Isn't it also dangerous to haul in the slack when the current is on?—No, it isn't so dangerous as making the joint. It would have been better to pull the slack through before making the coupling.

You admit that the safe plan would be to finish the work of hauling in the slack before coupling it?—It would be better.

Mr. HORACE MORTON TAYLOR, between 20 and 21 years of age, said he had passed through a course of electric instruction, and qualified as an electrician. He was in charge of the work on which deceased was engaged, and uncoupled the section in the usual way. Young and Lang were present beside him. Young made the joint. He thought Young had been out jointing about six months, and that Lang could make a joint. The current was turned off about 11 in the morning, and the joint was made and finished shortly after 3, and witness examined and passed it.

What was done then?—I put the current on, with the assistance of Young.

HIS HONOUR: Mightn't you have waited before putting on the current?

WITNESS: I did not consider it necessary.

Continuing his examination, WITNESS said the slack could not be pulled in till the coupling was done. Lang saw the coupling done, and when the current was on, because he carried the gear down for it, and on its being coupled carried the gear away again.

What was left to be done when you went away?—To braze and paint the joint and pull the slack back, and that I considered them competent to do, and went.

Did you see any gloves?—I used one pair, and I saw Young use the other; in fact, he couldn't couple without them. When I went away I left my gloves for them.

So that at the time the slack was pulled in there were two pairs?—Yes.

Were they like these? (produced)—Yes; that is one of the pairs. I had used them half an hour before.

HIS HONOUR: You were not there when the accident happened?—No.

By Mr. RUEGG: The current was put on about a quarter past three, and the accident took place a little after four. I believe I received the letter of warning as to the gloves from Mr. Gay, the manager.

Being questioned as to why he told Payne to do without gloves, or somebody else would do the work if he (Payne) didn't, WITNESS said Payne had some work to do on the main—to put in a switch plug, and, through carelessness or otherwise, he touched his hand slightly against a live part. He told me of this; and I told him that some one else would do it, and, from that day to this, one of the other electricians or I have done it.

Didn't he ask you for gloves?—No; he told me of the accident neither he nor Lang ever asked me for gloves.

Cross-examined: Why should you say somebody else would do the work?—Because, through his own carelessness, he had a shock, and I didn't think it was right for him to do that kind of work again.

Wasn't he going to do some more work?—Yes, but not work of that description.

It required gloves?—No, certainly not.

Why did you tell him some one else would do it?—As I said, he had done this particular work and got a shock over it.

By His HONOUR: Young did not go on with that particular work, and he had never done it since.

Cross-examination continued: It was my duty to connect the main when I thought it right. I know it is dangerous—there is a certain amount of danger in working a live cable, if it can be avoided by the power being turned off. I knew the hauling up the slack would have to take place.

Why didn't you wait till it was done before directing the coupling up to be made?—It was our system not to.

To allow men to haul the cable after the electricity was laid on?—It was.

With regard to the gloves, do you really mean to say you have a distinct recollection of seeing two pairs there that day?—It was our practice to do this work with two pairs.

Did you see them?—I did. I used one pair, and I saw Young use the other.

Do you know that at the inquest it was said he didn't use any?—No, I do not. I was not there.

Do you really mean to say you saw Young with the gloves on?—I did.

There were two pairs, then, for three men?—Yes, but the three of us wouldn't want to work at once.

Who brought them?—Young and the deceased, with the gear, which was contained in two boxes, and I saw Young using them during the coupling up and uncoupling. I was not there when the hauling up took place. Young and I coupled up; I went away, and he went back.

Who assisted you in coupling?—Young.

Who was in charge when you went away?—Young; he was making the joint.

And the other man was assisting him?—Yes.

Isn't it a fact that these men very seldom used these gloves at all?—I believe that was so; I could not say for certain. I could not say if I saw them with the gloves on at all, except for coupling.

DAVID YOUNG, the jointer, who was working with the deceased, said Lang used generally to go with him on that work for some six or seven months before. They would go sometimes two, three or four times a week, and sometimes not at all. He knew that Lang made two high-tension joints and several low-tension ones. He received the letter from Mr. Gay, the manager, about the gloves, and Lang read it to him (witness).

What did he say?—What did he say? I think he said, so far as I can recollect, he tore it up; he made a laugh, and tore it up.

At that time had you any gloves?—No.

When did you first have them?—We had gloves for disconnecting couplings.

How many pairs?—Two; you must have two pairs for disconnecting couplings.

His HONOUR: Did you see any gloves on the day of the accident?—Yes, there were two pairs.

Examination continued: I disconnected the coupling about 11 o'clock, and connected up about 3 o'clock, or a little after that. Taylor left when I had coupled up. As soon as I cut the joint and took the insulation off, Taylor said, "We'll go and connect the coupling up." Witness then described what was done, and proceeded to say: When I got the joint finished I said, "Tom, we'll get the slack back," and we opened the surface box lid, and I went back to my box to guide the joint in.

How long had the current been on at that time?—It might have been on nearly an hour, I should think.

Where was Lang during that hour?—Assisting me. Lang went to the surface box, and pulled nearly a yard of pull back.

Had he gloves on or not?—No.

There were two pairs there at the time?—Yes, two pairs.

He could have used them if he liked?—I suppose he could. I didn't stop him. Yes, I have pulled the slack in. If there is not a fault in it, I think a cable can pretty safely be handled with the bare hands. I have done it over two years, and I never found any harm come of it.

Can you account at all for the insulation being rubbed off in this case?—It might have been rubbed in the pipe, but we have before now found a dead mouse in the slack. If the insulation is gone, of course there is risk.

Haven't you been warned by the officials not to touch a live wire without gloves?—(Smiling) Well, I can't exactly say whether I have or no.

By a JURYMAN: Do you think it possible for a man to tread on the wire?—Yes.

As I understand it, he has to get down into the box, and he may accidentally tread on the wire?—It may be so.

Cross-examined: Lang was at the surface box.

Were his feet near the wire at all?—I don't think so.

It was close by, and could he have trodden on the wire?—I think the particular box was rather short.

You put on these gloves in the uncoupling and coupling?—Yes.

It was for this purpose you understood the gloves were provided?—Yes, only for that purpose, and understood merely for the purpose of coupling and uncoupling.

You had been working with Lang some time, and practically the same kind of thing was going on?—Yes.

And on this occasion you put on the gloves?—Yes.

Did you sometimes haul the slack wire?—I have, but not with Lang.

Did you put on the gloves then?—No; we never had them until the notice.

Has Taylor been by in other cases when you and Lang have hauled up the slack?—Yes, I think so.

In any of those cases, did Lang use the gloves?—Lang never used the gloves. On this occasion I was guiding the slack.

And you were liable to the same shock as he?—Yes, providing there was a fault where I held it.

Re-examined: WITNESS said he did not see a fault in the cable. Lang's hand was burnt, and he saw it actually smoking, so he supposed he did not step on the cable. It must have been inside the pipe where the fault was.

Mr. BELL asked WITNESS was he quite sure he saw Lang tear up the notice of warning, and he said he could not be positive about it; he thought he did.

Mr. BELL: But it could not have been so. His Honour has now before him Lang's original copy of the notice.

WITNESS: Well, it might have been the envelope he tore up.

There being three other witnesses yet to be examined, and the Court having now sat three-quarters of an hour beyond its usual time, the hearing was at this stage adjourned until Thursday in next week.

LESSERT v. THE TELEPHONE COMPANY OF IEELAND.

LAST week, before Mr. Justice Harrison and a city special jury, this case was heard. It was an action by Alfred Alexander de Lessert and William Henry Blenden, as owners in reversion of 29 and 30, Temple Bar, now in possession of Messrs. John and Patrick Tighe, to recover £600 damages for injuries alleged to have been caused by the defendants, the Telephone Company of Ireland, to the premises in pulling down an adjoining house. The defendants' case was that they were not liable, and that if there was any liability it was on the contractor who worked for them. There had been a previous trial, on which there was a finding by direction for the defendants. The plaintiffs obtained a new trial and the case was reheard.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

(*Continued from page* 198.)

Dr. FLEMING, in the course of his reply, said the more carefully one looks into the matter, the more firm becomes one's conclusion that the economical radius of supply by three-wire direct current systems is reached at distances when the feeders have an average length of somewhat less than one mile with load diagrams of 10 per cent. But the case becomes much more unfavourable to the low pressure supply if we suppose the load diagram to improve. We do not build our stations with the object or hope of remaining permanently with load-factors of 10 per cent. No one is making greater efforts than Mr. Crompton to increase these abnormally low load-factors. Examine then, what will be the result of improving the load-factor—in every case it must be to diminish the efficiency of the low pressure feeder. This is clearly obvious, because, if the load-factor rises to 100 per cent., the efficiency of the feeder with the 40 per cent. drop would only become something like 70 per cent., and this is the limit towards which the efficiency of distribution of the low pressure system tends, as the load-factors are progressively increased when secondary batteries are not used. On the other hand, it is a matter of simple demonstration that in proportion as the load-factors increase, the efficiency of distribution of the high pressure feeder must tend as a limit towards 95 per cent., 2 per cent. being the drop in the line, and 3 per cent. the loss in the transformer. In all cases, therefore, in which large load-factors are expected to be found, we see the wisdom of the selection of an alternating current system. Those of you who know, or can imagine what the load diagram of one of the City of London stations is like on a foggy day, will see how well-advised have been the authorities who settled and selected an alternating current system for the lighting of the City of London. In all the discussion I have altogether left out of account for the present moment the capital outlay on the generating plant, but there is an important point which must not be lost sight of in this matter: To supply a maximum of 100 kilowatts at the business end of a high pressure feeder, we have only to put down a generating plant capable of supplying, at the maximum, 105 kilowatts at the dynamo end, because the losses at full load are only 5 per cent.; but, if we select a low pressure feeder to do the same work, we have to put down generating plant with a capacity of 140 kilowatts as its maximum output, because the maximum waste of 40 per cent. occurs in the low pressure feeder at the very hour of maximum demand at the business end. This, of course, very seriously affects not only the whole capital outlay in generating plant, but the whole annual costs of the system opens up a view of the case which must not be lost sight of in considering all these questions. In fact, the enthusiastic advocates of low pressure working have done their utmost to draw the attention of the world to the losses occurring in transformers, but they have judiciously kept exceedingly silent on the equally important matter of the losses in low pressure feeders. It is impossible to deny that the system of house transformers is one in which the all-day losses are exceedingly large, but none of us who, at any time, have advocated alternating current systems have ever looked upon that house-to-house system as anything more than necessary in initial stages of supply. In this case where the alternating current stations have been, or are being, laid out with knowledge and skill and experience from the beginning, nothing but a system of transformer feeders and low pressure secondary networks is being adopted, and when we come to collate the results of sufficient experience of the working of that system with the results of working of low pressure systems, there is no reason to believe that the balance of advantage would be found on the side of the continuous current system. Up to the present the figures that have been available for comparison have been entirely drawn from acknowledged imperfect systems of alternating current supply, and, hence, we have never been able to institute any fair and proper comparison between the two systems. One of the most remarkable qualities of a low pressure feeder is the degree to which a very moderate duration of full load depresses the efficiency of distribution. An 18 per cent. load factor when taken as 4½ hours at full load is quite as effective in lowering the efficiency of the feeder as a 24-hour supply at full load would be. If, however, we consider the alternating current feeder, the above facts are conversely illustrated. The higher or more concentrated the load factor, the better the efficiency of distribution. I take it to be demonstrated that on such a 10 per cent. load factor as I have taken the economical radius of transformation is reached at less than one mile. That is to say, if electric energy has to be delivered on such a load diagram at an average distance of one mile, it can be done more cheaply both on first cost and annual outlay by a transformer feeder than by a low pressure three-wire feeder. It is clear also that in spite of contrary views this economical radius of transformation will be decreased as the load factor increases. And that unless all the circumstances of the load are stated we are not in a position to definitely say which method has the advantage in point of economy.

NEW PATENTS—1893.

2,552. "Improvements in the construction and control of arc lamps." R. PIPPETTE. Dated February 6th.

2,557. "Improvements in and connected with electrically-driven screw propellors." H. T. BARNETT. Dated February 6th.

2,583. "Improvements in electrical indicators, which improvements are also applicable to electric belts, watches or other apparatus." G. HAYWARD. Dated February 6th.

2,586. "An improved diaphragm for electrolytic cells." C. N. WAITE. Dated February 6th.

2,592. "A microphonic amplifier of sound." E. HARDY. Dated February 6th.

2,593. "Improvements in or connected with telegraph pole fittings." J. C. FULLER, G. FULLER, and W. E. LANGDON. Dated February 6th.

2,597. "Process for bleaching raw starch, starch gum, and solutions thereof, by treatment with chlorine and ozone combined." SIEMENS BROTHERS & Co., LIMITED. (Communicated by Messrs. Siemens and Halske, Germany.) Dated February 6th.

2,598. "Processes for effecting the electro-deposition of metals upon aluminium." C. D. ABEL. (Communicated by G. Lebnert, Germany.) Dated February 6th.

2,600. "Improvements relating to electric incandescent lamps." R. HADDAN. (Communicated by G. Dedreux, Germany). Dated February 6th. (*Complete.*)

2,625. "Improvements in car couplings." R. W. BARKER. (Communicated by the La Burt Electric Block Signal System and Car Coupler Company, United States.) Dated February 6th. (*Complete.*)

2,632. "Improvements in electric lighting." G. R. ROLLASON and C. A. ROLLASON. Dated February 6th.

2,672. "Transmission of power by high potential direct currents of electricity." C. S. BRADLEY, R. T. MCDONALD, and R. S. TAYLOR. Dated February 7th. (*Complete.*)

2,674. "Improvements in combined electric cut-outs and door locks." J. H. L. HOLCOMBE. Dated February 7th. (*Complete.*)

2,690. "Improvements in apparatus for recording and reproducing articulate speech and other sounds." C. A. RANDALL. Dated February 7th.

2,696. "Improvements in telautographs or writing telegraphs." P. A. NEWTON. (Communicated by E. Gray, United States.) Dated February 7th. (*Complete.*)

2,703. "Improvements in high tension electrical fuses." D. BATES. Dated February 7th.

2,725. "Improvements in incandescent electric lamps." W. F. TAYLOR and G. F. BARNES. Dated February 7th.

2,740. "Improvements connected with electric arc lamps." J. J. RATHBONE. Dated February 7th.

2,744. "Improvements in the means for applying the static electrical brush discharge to the human body for curative purposes." W. CLAYPOOLE. Dated February 8th.

2,888. "Electric fog signal." H. BROCKLEHURST and H. CONSTIEN. Dated February 9th.

2,922. "Improvements in electric clocks." H. SCOTT and H. K. BURNET. Dated February 9th.

2,940. "Improvements in the electric dissociation or modification of gases, gaseous compounds and products." J. E. RICHARDSON. Dated February 10th.

2,946. "Improvements in or relating to galvanic batteries." R. J. CROWLEY and J. R. GRANT. Dated February 10th.

2,977. "Electric communications with lightships and other vessels." J. BUCHANAN. Dated February 10th.

2,992. "Improvements in bearings for shafts or axles, more especially adapted for dynamo-electric machines, electric motors, pulley blocks, and similar apparatus." A. GASCOINE. Dated February 10th.

3,053. "Electric light display system." F. W. GOLBY. (Communicated by D. McFarlan Moore, United States.) Dated February 11th. (*Complete.*)

3,071. "Improvements in or connected with automatic electric signalling on railways." THE AUTOMATIC ELECTRIC RAILWAY SIGNAL COMPANY, LIMITED and E. BLAKEY. Dated February 11th.

3,073. "Improvements in telephones and telephonic and telegraphic relays." M. KOTYAD and W. MOSELEY. Dated February 11th.

3,092. "Improvements in electric arc lamps." L. A. HINDLEY. Dated February 11th.

3,101. "Improvements in armature insulators." C. W. JEFFERSON. Dated February 11th.

3,118. "Improvements in electrical conductors." H. EDMUNDS. Dated February 11th.

3,119. "Improvements in the formation of solid ends on flexible or compound electrical conductors." H. EDMUNDS. Dated February 11th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

The Price of all Specifications (old and new) is now 8d. each.

7,954. "Improvements in and relating to electric call apparatus." G. POORE. Dated May 8th. Consists of any suitable type of electric call apparatus, to which is applied, or with which is combined, a locking appliance of suitable kind freed by the action of coin and adapted when so freed to operate, or release and operate, or allow to be operated, directly or indirectly, the transmitting mechanism, and so transmit, or allow to be transmitted, any given predetermined signal. 3 claims.

8,225. "Improvements in arrangements or apparatus for starting, working, and stopping or controlling signals by electricity, also applicable for other purposes." J. A. F. ASPINALL and H. A. HOY. Dated May 13th. Relates to an arrangement in which bell signals have to be started into operation by an electric current which passes from a line battery only for a moment of time, namely, such currents as those which are caused to operate by a locomotive or train passing a given point on the railway, which locomotive or train acts upon a treadle, or in consequence of the deflection in the rails. 6 claims.

10,843. "Improvements in apparatus for regulating electric currents." J. FERRAND. Dated June 25th. One or more carbon resistances is or are used, connected for tension or for quantity and composed of pieces of carbon (hereinafter called carbon plates) that may vary in form, dimensions, and numbers according to requirements; and which are maintained side by side in a row by an insulating mount. The regulating apparatus is constructed with an electro-magnetic device that acts automatically with a variable pressure upon the carbon plates when the current to be regulated varies. 4 claims.

11,294. "An improved system of telephonic exchange signalling." A. R. BENNETT. Dated July 3rd. Claims:—1. The system of intercommunication between the subscribers and operators in a telephonic exchange system by means of induction between a special wire, sheath, coil, plate or equivalent device, to which the operator's instrument is connected, and the conductor or conductors of the line itself when suitably connected to the subscriber's instrument. 2. The various specific modes of giving effect to the said invention.

11,313. "Improvements in means or apparatus for utilising electrical energy in operating hammering, rock-boring, and other reciprocating mechanism." R. BOLTON. Dated July 3rd. The inventor arranges the reciprocating tool, piston rod, or other mechanism desired to be reciprocated by power with a connection of suitable form to a vibratory or reciprocatory magnetic coil, excited by the electric current, and which may be wound with a coil of wire preferably laminated in the direction of the magnet's length, and the winding led in a certain given circular direction, either from right to left or left to right, with a view to obtaining a given corresponding resulting pole at the respective ends, when the coil is excited by the passage there-through of the current. Oppositely situated facing each end of the reciprocatory magnet described, are two or more fixed coil magnets of similar construction, and which are secured to the framing of the machine at such a given distance apart as will determine the proper stroke or limit of travel of the central reciprocatory magnet. These fixed magnets are wound in reverse directions, one being formed with a right handed helix, and the other with a left hand helix, but the end of the coil of one is connected to the commencement of the coil of the other, and the remaining ends to the electric leads. That is to say, the coils are in series with the dynamo operating same. By reversing the current through either the fixed or reciprocatory magnets, exactly opposite effects are set up, and where propulsion existed, repulsion is caused, and *vice versa*. 5 claims.

CORRESPONDENCE.

St. Pancras Electric Lighting.

In your "Notes" of last week you say:—"We hear that the electricity accounts formed the subject of discussion at the meeting of the West St. Pancras Ratepayers' Association on Tuesday last. There was much grumbling regarding the last increase of rates."

The lighting rate in St. Pancras for half-year was in 1878 down to 1881 1½d. in the £, it then ran on a few years at 1d., in 1889 it was 1½d., in 1890 1½d., 1891 1d., 1892 1d., and the last rate 1½d.; in brief, during the past 17 years the rate has been 1½d. for the winter half-year eight times.

There has not been any *rate* made on account of electricity whatever.

Your insertion of this on behalf of municipal electric lighting will oblige.

Andrew Sweet,
Chairman of St. Pancras Electricity and Public Lighting.

A Question for the Horse Marines.

Would you kindly inform me through your columns how much electricity is equal to 1 horse-power nominal of a marine engine. I enclose my card.

Automatic.

February 15th, 1893.